THE MONTHLY BULLETIN.

CALIFORNIA STATE COMMISSION OF HORTICULTURE

Vol. V. January, 1916. No. 1

SMYRNA FIG GROWING IN CALIFORNIA.

By Henry Markarian, Fresno, Cal.

SOIL ADAPTED TO FIG CULTURE.

To grow figs successfully in California one must study the nature of the soil and the climatic conditions. The best region in which to grow the world-famed Smyrna and the White Adriatic figs for drying commercially would be the eastern portion of the San Joaquin Valley lying between Merced and Bakersfield, especially the region near the Sierra foothills. Other sections fairly well adapted to fig culture are in northern California, the region lying between Marysville and Red Bluff in the Sacramento Valley and in southern California the interior valleys, where in summer the climate is dry, almost entirely rainless, free from fogs and excessive dews, and where from June to September the temperature ranges from 90 to 100 degrees or over in the shade.

A soil that is heavy, rich, and deep, inclined to be reddish in color, and with plenty of irrigation water, is desirable. In this kind of soil a planting distance of 33 by 33 feet to 40 by 40 feet is recommended. Red soil underlaid by red hardpan from twelve inches to three feet, if properly blasted, is good. This soil contains an abundance of iron, lime and potassium, the elements essential to the successful culture of figs. Although trees take one or two years longer to mature in this kind of soil, still it will produce clean, white and elegant fruit, with hardly any that are sour or split. The life of the tree under these favorable conditions would be almost everlasting; in this kind of soil, plant 30 by 30 feet; but in sandy soil (drift sand), alkali, or in places where the high-water level is three feet below the surface, it is impossible to grow fig trees successfully. Neither are bottom lands adjoining rivers suitable, as the figs are inclined to sour and split.

LEVELING THE GROUND AND PLANTING.

For planting the fig tree I would recommend level land, if possible, so that during irrigation the water will not form pools and cause stagnation. The ground should be leveled into large checks, so that when irrigating the water can be held back to give an even distribution over the entire surface of the land. If it is not level, grade the land similarly to orange orchards and adapt the furrow method of irrigation. Run several furrows between the rows so that a stream of water can run down the furrows for two or three days each time when irrigating. This is absolutely necessary for two years after planting, in order to insure a rapid growth of the trees, which will, no doubt, hasten the trees into early bearing. The ground should be plowed not less than eight

inches in depth in order to break thoroughly through the plow-pan or crust. After the ground is well pulverized, dig holes a depth of from eighteen to twenty inches.

The best time for planting fig trees is in the months of February and March. When planting, go over your nursery stock and cut the trees to a uniform length of two feet from the cutting joints. This will allow the trees to branch or fork twenty inches above the ground, which is the only proper way. Wax the tips to seal the sap of the trees and prevent their drying, then plant so that at least three inches of the cutting joint is down in the soil. It is very important that the fig tree, when being planted, should not be unduly exposed. When the trees are taken from the nursery bed, they should be kept in a barrel of water and taken out one by one in the course of planting, as the trees can not stand more than ten minutes' exposure to the cold wind or the hot sun.

FIG. 1.—The Smyrna fig tree develops best when headed low so that the top shades the trunk and protects it from the sun. (Original.)

The fig tree fibers are as fine as hair and can be easily dried up by this exposure. After planting the tree, water it thoroughly to settle the earth around the roots and shut out the air, using at least ten gallons of water to a tree. The same precaution should be taken while the trees are hilled in the nursery bed. Do not neglect to do this or even wait until you get ready for irrigation, as many trees have dried up in the course of three or four weeks without water. Then use either a tree protector or redwood stakes four feet long to brace the trees. Drive the stakes on the southwest side and tie the tree to the stake. These stakes not only brace the trees, but they protect them from the severe frost and from the hot afternoon sun which usually follows the frost. I have found from personal experience that in all cases the effect of injury from frost appears on the southwest side of the trees.

IRRIGATION.

After a month or six weeks irrigate the trees or water with tank wagon. If irrigation is possible, run furrows on each side of the row three feet away, and let the water run; but care must be taken not to let the water run into low places and form deep pools, as young trees—especially those planted the first year, can be as easily drowned as dried. After each irrigation, hoe around the trees as deeply as possible and cultivate deeply from three to four times. The trees should be irrigated the first year during the months of June, July and August; the

FIG. 2.—Tree the same age as the one shown in the previous illustration, but the trunk is half dead from frost and sunburn. (Original.)

second year during July and August, and the years thereafter during May and July. When the orchard is eight to ten years old irrigation by flooding, similar to the method used in alfalfa fields or orange orchards, is recommended. The ground should be thoroughly soaked each time it is irrigated.

PLANTING.

I should like to warn fig growers that they must be very cautious in buying trees from nurseries. Insist upon the true "Lob" variety. This is the real world-famed Smyrna fig of commerce.

The Smyrna—or sometimes so-called Calimyrna—figs have over a hundred varieties in this State, nearly all of which are seedlings. As a rule the seedlings are defective in many ways: they may be poor, have smaller fruit, or be lacking in sugar. A few of the varieties will make fairly good table figs.

The fig has many peculiarities; one of them is that fig trees grown from seeds will become two-thirds female, and one-third male. Almost every one of the seedlings represents a different kind of tree.

FIG. 3.—One year old Smyrna fig tree before pruning.
(Original.)

FIG. 4.—One year old Smyrna fig tree after pruning.
(Original.)

The Lob-Ingir variety was no doubt propagated from the very best male and female figs by the ancients, and it is doubtful if this variety can be excelled. Lob-Ingir is the Turkish term used to designate the symmetrical shape of this luscious fruit, and is derived from a popular usage of offering fruit, same to be taken at one *gulp*. The attractiveness of the fruit is particularly noteworthy.

PLANTING OF CAPRI TREES.

In growing Smyrna fig trees it is essential to plant from three to five capri trees to every hundred Smyrna trees, either in a grove by themselves, where they will be convenient for close observation, or in a segregated row running through the center of the orchard.

A peculiarity of the fig tree is its method of flowering. Other deciduous trees bloom before the fruit appears, after which the foliage and the fruit grow almost simultaneously. On the fig tree the foliage first appears, with some scattering figs, which are called early figs or first crop, then branches develop from six to ten inches in length, depending on the age of the tree. This growing period extends from the latter part of March to the fifteenth of May, at which time the tree ceases to branch. Then the figs for the first time are plainly apparent on the tree. Three or four figs appear on the lower part of the branch during the first week of production, two or three more during the second week, and finally one or two more figs appear at the end of the branch during the third week of production. Because the figs do not all mature at the same time, it is absolutely necessary to have the early, medium and late varieties of capri.

The selection of capri trees requires careful attention. The following facts will give some idea of different varieties: The Markarian No. 2 and Roeding No. 3 ripen very early; the Markarian No. 1 and *pseudocarica* ripen fairly early; the Milco is a late capri, which prolongs the caprification season, thereby fertilizing all the remaining figs on the trees. The *pseudocarica* has another important feature: the pollen appears on the Mamme, which fertilizes the first crop of Smyrna figs ripening in June. Heretofore all the first crop, or the June figs, went to waste from lack of pollination; the introduction of *pseudocarica*, however, will save the early figs, which can be shipped green and bring a handsome profit.

It is absolutely necessary to plant 60 per cent of the capri trees into the early varieties, as this early capri means the pollination of 70 per cent of the crop. Plant 20 per cent of each of the medium and late varieties, which together pollenize 30 per cent of the crop. My favorite capris are Markarian Nos. 1 and 2, Roeding No. 3, the Milco, and *pseudocarica*. The above are the important varieties, and if desired other less important ones may be added.

PRUNING SMYRNA FIG TREES.

Although fig trees do not require as much pruning as other deciduous trees, they should be pruned and shaped up. Allow the trees to branch into forks when they are from sixteen to twenty inches from the ground, because if the trunks are allowed to grow more than two feet, the trees will be liable to bend, will be exposed to frost and sunburn and become

Fig. 5.—Two year old Smyrna fig tree before pruning.
(Original.)

Fig. 6.—Two year old Smyrna fig tree after pruning.
(Original.)

Fig. 7.—Three year old Smyrna fig tree before pruning. (Original.)

Fig. 8.—Three year old Smyrna fig tree after pruning. (Original.)

stunted. I have seen many fig growers prune their trees high, that they might drive their teams under the trees and give close cultivation; but they ruined their trees. The fig tree must be shaped as nearly like an umbrella as possible in order to absolutely shade the trunk from frost and sun on all sides. I have further observed that all the large and vigorous trees are the trees whose trunks are well shaded. When the trees come into maturity, after the fifth or sixth year, they must be pruned back so that the lateral branches will become thick and dense. The foliage thus produced will shade the limbs, which would otherwise be burned by the sun. This method must be followed every two years thereafter in order to make new lateral fruit wood and insure large fruit and a large crop.

CAPRIFICATION.

The Smyrna figs contain nothing but female flowers, and unless they are pollinated the fruit will not mature; they will grow to the size of a marble and then drop off. A similar principle applies to the caprifigs

FIG. 9.—Ten year old Smyrna fig tree before pruning. (Original.)

containing no insects; the fig grows to three-fourths of its normal size and drops before maturing. The figs that carry over on the trees until they mature are fertile figs. The fig wasp or Blastophaga develops in the caprifigs, or, in other words, these insects are a part of the tree. They hatch three times a year—in some varieties four—the generations being distinguished as follows: Mamme is a winter crop, ripening about the first of April; the Profichi matures in June, and the Mammone is a summer crop, maturing in fall. Each of these crops has a mission to perform. The Mamme propagates or fertilizes the Profichi, producing from 500 to 2,000 caprifigs to a tree. The Profichi pollinates the

Smyrna fig, and produces from 5,000 to 15,000 caprifigs to a tree, sometimes producing more figs than leaves. It is well to remember that the entire crop of Smyrna figs depends on the Profichi. And lastly, the Mammone, whose function is to preserve the link of generation, produces from 100 to 200 caprifigs to a tree.

The Blastophaga do not develop in the Smyrna fig, but are employed simply as factors for carrying the pollen into the Smyrna fig. The male hatches first; he crawls about the interior of the caprifig, seeking a gall which contains a female wasp, opens a hole with his powerful mandibles

FIG. 10.—Ten year old Smyrna fig tree after pruning. (Original.)

in the cortex of the ovary and mating occurs while she is still inside the gall. The female at once begins to enlarge the hole made by the male and crawls out of the gall.

When the Profichi crop matures the pollen appears in abundance. The female wasps emerge from their birthplace—the caprifig—dusted with the pollen which collects on them while crawling through the cluster of stamens; immediately they fly away, seeking a new home in which to lay their eggs for the next generation.

As already stated, the fig tree differs in many respects from all other deciduous trees. The fig blooms inside when it is the size of a marble or a little larger, at which time one can get a whiff of perfume-like fragrance from the tree when passing by. The insects, enticed by this odor, at once fly toward the fig and alight on the Smyrna fig, seeking for the orifice or eye, which is closed by overlapping bracts. Sometimes the overlapping bracts are so tightly closed that the insects are obliged to cut away with their powerful mandibles to effect an entrance into the interior, and then they crawl through the orifice of the Smyrna fig, seeking for a gall flower in which to lay their eggs. In an endeavor to

find such a place, the insects come into constant contact and friction with the female flower in the Smyrna fig, and in so doing dispose of the pollen which they collected; disappointed, they emerge from the fig, often wingless, and perish.

While there is an abundance of Profichi for the purpose of pollinating the Smyrna fig, nature has only provided a few Mammone capris to connect the generations; but, needless to say, the few insects multiply into myriads in the following generations.

The female insect is black and has four wings; the male is red and wingless. The caprifigs contain from 500 to 3,000 male and female

FIG. 11.—Caprifigs are distributed in the early morning, placing the proper number in a wire basket suspended from a limb. (Original.)

wasps, one-fourth of which are male and three-fourths female. Of course, these figures vary in the different species of capri. The Markarian No. 1 contains more insects and pollen than any other capri I have known. In many of my capris I have counted as many as 3,000 wasps in one fig.

Caprification is very simple and intensely interesting. One need not be a botanist to do the work. Any ordinary ranch hand in a few days can acquire sufficient knowledge to perform the operation. After the Smyrna fig trees reach their maturity, which is the fifth or sixth year, of course depending largely on the attention and consequent result, the trees must be caprified to reap the benefits from the orchard, after years of waiting. The caprification season commences about the tenth of June and ends about the fifth of July.

To decide whether a caprifig is ripe, cut one open and observe whether any male insects have emerged. As already stated, the male comes out of the galls first. Their presence indicates whether part of the female insects have migrated or are about to migrate. The practical way of

picking caprifigs is to have a man go up into the tree with a ladder, and finding the soft ones, which are ripe, drop them to the ground. Caprifigs, like other figs, do not mature all at one time. After the tree has been gone over, the figs should be picked up from the ground as quickly as possible, as they should not be exposed very long to the hot sun.

The best time for picking caprifigs is from two o'clock in the afternoon until dark. Then, about four o'clock in the morning, distribute them in the orchard. This work must be completed before the day gets warm, prior to nine o'clock, as the insects begin to come out at about this time and continue to issue for three hours after that. After nine o'clock they should not be disturbed, as the insects will likely be destroyed. A peculiar characteristic of the capri is that after twelve o'clock at noon the insects cease to issue. This is the reason that the caprifigs should be

FIG. 12.—Figs dry partially on the trees and fall to the ground, from which they are picked up every few days and taken in lug boxes to the drying yard. (Original.)

picked in the afternoon and distributed early in the morning. The cost of picking and distributing the caprifigs in the orchard and into the baskets, as often as is necessary, will not exceed one dollar per acre.

Caprifigs are placed in wire baskets made with ¾-inch wire mesh, 4 inches wide and 10 inches deep, with a hook made from galvanized wire, which makes it easily removable from the tree. In the fifth year, when the Smyrna trees begin to bear profitably, apply five caprifigs to each tree once a week for three weeks. As the trees get older, the number of capri must be increased as follows:

5th year of bearing, distribute	15 caprifigs;	5 figs every 8 days.
6th year of bearing, distribute	24 caprifigs;	6 figs every 6 days.
7th year of bearing, distribute	50 caprifigs;	10 figs every 5 days.
8th year of bearing, distribute	78 caprifigs;	13 figs every 4 days.
9th year of bearing, distribute	104 caprifigs;	13 figs every 3 days.
10th year of bearing, distribute	120 caprifigs;	15 figs every 3 days.
11th year of bearing, distribute	144 caprifigs;	18 figs every 3 days.
12th year of bearing, distribute	176 caprifigs;	22 figs every 3 days.

THE SMYRNA FIG SUPERIOR TO ALL OTHER FIGS.

The statement is often made that the Adriatic fig is the best variety to plant; on account of its heavy production and the consequent profit. I have been asked which variety is the most profitable to plant, and have replied: "The Smyrna." This question is exactly like asking which grape makes the best raisin. The answer is, of course, the Muscat, although the Feher Szagos yield more raisins and consequently bring more returns per acre. However, when there is a normal Muscat crop, there is practically no demand for the Feher Szagos and consequently no price which would pay the grower. The Feher Szagos is in demand only when there is a shortage of the raisin crop, because it is an inferior raisin and detracts from the good reputation of the Muscat. This logic applies to the White Adriatic fig.

The reports current as to the White Adriatic orchards yielding from three to four tons an acre are for orchards located in exceptionally rich and heavy soil, such as Rodger's orchard in Merced, McHenry's in Modesto, and several orchards in the vicinity of Yuba City. It should, however, be borne in mind that these orchards are twenty-five years old. At the present time there is no Smyrna fig orchard in existence in California, excluding Roeding's, which is over twelve years old. And the erratic information that the production of the White Adriatic fig surpasses that of the Smyrna will be dissipated when the Smyrna fig orchards, planted in exceptionally rich and heavy soil, reach the age of twenty-five years.

I have several reasons for advocating Smyrna fig culture: first, the superiority of the fruit; second, the quick maturity of the trees—Smyrna fig trees mature in six years, White Adriatic in eight years; third, the trees show very little or none of the root diseases so common to Adriatics; fourth, the trees are well adapted to orchard form when they are planted 30 by 30 feet apart, whereas the Adriatic at this distance would not be satisfactory; and furthermore, the tendency of the Smyrna fig tree roots is to go downward and deeper into the soil, while those of the Adriatic have a tendency to spread circumferentially in a shallow depth; fifth, because it is a fine and luscious fruit, almost free from souring, and of great nutritive and medicinal value. The Smyrna fig may be shipped green and find a ready market with every prospect of good financial returns.

As to the production of the Smyrna fig, it is very hard to give a definite maximum figure, as there are only a few orchards now in full bearing in the State, and practically all of these are young orchards. The most I can do is to give the comparative production of the Smyrna and the Adriatic in my own orchard. Both varieties have produced equally heavy crops and both have constantly increased the average production per acre, which at present is over two tons. This amount will increase as the trees grow older, and will doubtless reach a maximum production of four to five tons per acre when in full bearing at the age of fifteen years.

In all my experience in fig culture in California I have never seen a total failure. We have had severe frosts and early September rain storms, which lessened the crop one-fifth of its normal production, but never totally destroyed it. The grower can almost always rely on a crop.

At the age of fifteen years the tree is considered to be in its full bearing stage, when planted at a distance of 30 by 30 feet, and the amount of caprifigs to be hung on the trees will be from 175 to 200. The above figures are for a normal sized tree; however, if the trees are exceptionally large, apply a few more; if smaller than the average, apply a few less. In other words, apply according to the size of the tree.

Many growers have complained that the Smyrna fig does not produce as heavily as other figs. I have investigated and found that this shortage in every case is due to lack of sufficient pollination. For instance, my trees are now twelve years old, and I have gone over my

FIG. 13.—Figs are dried on trays placed directly in the sun or stacked up one above the other so that the air can circulate freely between them. (Original.)

orchard eight times during the caprification season, hanging an average of 150 caprifigs to each tree, thereby giving my orchard a thorough caprification. If your caprifig supply is inadequate for your orchard, I should advise you to buy a sufficient quantity to thoroughly supply the requirements. They cost only $5.00 per thousand, and I assure you it will not pay to allow your figs to drop off from lack of pollination. I have investigated the Smyrna figs after pollination and observed no injury sustained by excessive caprification.

HARVESTING SMYRNA FIGS.

The Smyrna fig ripens from the fifteenth or twentieth of August until the first of October. When the figs ripen, they shrivel up and drop from the trees to the ground. Once a week they are picked up, put into 40 or 50 pound lug boxes and hauled to the drying yard; there they are spread on trays, stacked and covered and allowed to remain in stacks a

week or ten days, or until they are dry. The figs are then removed from the trays and washed in a water solution of 5 per cent salt and ½ per cent lime. If the figs are too dry, allow them to remain in water for about twenty minutes, after which remove and spread them back on the trays and stack. Let them remain in stack for one week only, in October. But later in the season spread the trays out in the sun until they are dry; after that, sort out all defectives and put in sweat boxes ready for delivery to the packing house. White Adriatics are processed in a similar way, except that the Adriatics are bleached by sulphur.

The following is the tabular comparison of the distance and increasing production yearly per acre of Smyrna figs. This table can also be applied to the White Adriatics, with the exception that the Adriatics come into maturity two years later:

TABLE SHOWING THE PRODUCTION OF SMYRNA FIGS.

Bearing age	Exceptionally heavy, rich soil. Number of trees per acre, 27; planted 40 ft. by 40 ft. Yield, pounds per acre	Extra heavy, rich soil. Number trees per acre, 40; planted 33 ft. by 33 ft. Yield, pounds per acre	Very heavy soil. Number trees per acre, 48; planted 30 ft. by 30 ft. Yield, pounds per acre	Medium heavy soil. Number trees per acre, 69; planted 25 ft. by 25 ft. Yield, pounds per acre
Fifth year	283	420	500	725
Sixth year	457	680	800	1,173
Seventh year	675	1,000	1,200	1,725
Eighth year	918	1,320	1,600	2,208
Ninth year	1,242	1,680	2,050	2,967
Tenth year	1,590	2,040	2,500	3,419
Eleventh year	2,000	2,450	3,000	3,735
Twelfth year	2,450	2,960	3,500	4,000
Thirteenth year	2,950	3,600	3,900	*
Fourteenth year	3,450	4,100	4,300	
Fifteenth year	4,000	4,600	4,600	
Sixteenth year	4,500	5,000	6,000†	
Seventeenth year	4,950	5,400		
Eighteenth year	5,350	8,000†		
Nineteenth year	5,750			
Twentieth year	6,150			
	10,000†			

*Full bearing. †Possibly full bearing.

CONCLUSION.

I am fully convinced, judging from unabated activities shown in the production of Smyrna figs, that this industry is destined to become one of the leading fruit industries of California. The Turkish statistics show that the annual production of Smyrna figs in Meander Valley in Asia Minor, is over 120,000 camel loads, each camel load averaging 600 pounds, making a total of 72,000,000 pounds. Of this, one-half is exported to the United States. The total output of figs in California is about 6,000 tons, 1,000 tons of which are the Smyrna variety, which indicates that 80 per cent of the figs consumed in the United States are of the Smyrna variety. Furthermore, as the industry grows, there will be a constant increase in price for the Smyrna variety. Its price per pound ranges from 5½ to 7 cents at present, whereas the Adriatic is bringing from 3¾ to 4 cents per pound.

THE NEED OF A STATE-WIDE DRIED APRICOT GROWERS' ASSOCIATION.

By Robert E. Harrington, Simi, Ventura County, Cal.

With a very large acreage of young apricot trees coming into bearing, with the foreign market for dried apricots seriously injured by the war, and with many apricot growers selling their product at less than the cost of production, the future for the dried apricot grower looks very unpromising, unless he is willing to co-operate with his fellow growers in the organization of a state-wide dried apricot association.

INCREASED ACREAGE.

According to statistics furnished by the State Commission of Horticulture there were 44,535 acres planted to apricots within the State in 1914. Of this number 10,195 acres are under bearing age, 6,859 acres being in southern California alone. As there is no report of the nonbearing acreage in Los Angeles County it is quite likely that considerable of the nonbearing acreage was not included in these figures. Planting was very heavy this year, and it is safe to estimate that there are 15,000 acres of nonbearing apricot orchards in the State at the present time.

FOREIGN MARKET.

Europe used to take about three-fourths of the dried apricots produced in California, and Germany was the heaviest buyer. Even if the war should end soon, it would be many years before Europe could take many dried apricots, for they are costly to produce and necessarily sell for a higher price than other food products, and the warring nations will be very poor for a long time.

COST OF PRODUCTION.

What does it cost to produce a pound of dried apricots? R. L. Adams, Professor of Agronomy at the University of California, after careful figuring makes the following statement in regard to the cost of production of the various dried fruits:

> Growers should get the following prices for their crops, if they are to cover all items entering into a businesslike management of their affairs:

	Usual crop of ½ ton per acre	Good crop of 1 ton per acre
Apricot	12½ cents	7½ cents
Prune	2½ cents	2 cents
Peach	6½ cents	5 cents
Pear	9½ cents	5½ cents

From the above it will be seen that the cost of production is very high when compared to that of other dried fruits.

The items entering into the cost of production of dried apricots, as figured out by the writer, are about as follows. Cost of establishing orchard:

Cost of suitable land with water, per acre	$200 00
Cost of trees, leveling and planting	30 00
Cost of maintenance for five years	120 00
Total cost per acre at fifth year	$350 00

This $350.00 represents the investment per acre and is about what one would have to pay for a five year old orchard if purchased from another or established by himself, as shown by the above figures. Figuring on this $350.00 per acre investment the yearly expense connected with each acre of bearing orchard would be:

Interest on investment (6 per cent on $350.00)	$21 00	
Cost of management (if $1,200.00 man can manage 100 acres)	12 00	
Yearly depreciation (figuring that the life of the orchard will be twenty years after it begins bearing the cost of maintenance for first five years amounting to $120.00 should be distributed over these twenty years, making the yearly charge for depreciation $6.00)	6 00	
Taxes	3 00	
Expense of maintaining orchard		$42 00
Pruning (the apricot requires heavy pruning)	$12 00	
Cultivating and plowing	12 00	
Irrigating	10 00	
Fertilizing (to maintain the fertility of the land enough fertilizer must be added to replace what is taken off in the crop and pruning brush)	4 00	
Spraying (not necessary every year)	2 00	
Total expense for maintenance		40 00
Total expense connected with each acre of orchard each year as obtained by adding the above is		$82 00

The cost of harvesting a ton of dried apricots varies between $50.00 and $65.00 per ton, according to conditions. Figuring on $58.00 per ton as cost of harvesting and on one ton per acre crop, it would cost $82.00 plus $58.00, or $140.00, to produce a ton of dried apricots. This amounts to 7 cents per pound. I think the average crop is not over three-fourths of a ton and, figuring on this, it would cost $168.00 per ton or about 8½ cents per pound. If less were spent on care of the orchard, the crop would be less and the cost of production still higher.

From the above it will be seen that most of the dried apricots were sold this season at less than the cost of production. This is a very serious condition of affairs, especially when one considers the condition of the foreign market, the rapid increase in production and the fact that almost no attempt is being made to increase the consumption of apricots in the United States. But there is hope.

CO-OPERATIVE MARKETING ASSOCIATIONS.

Growers of other fruits and nuts have gone through similar experiences and through the formation of co-operative marketing associations have obtained great results.

Every one is familiar with the great success of the California Fruit Growers' Exchange, which markets over 60 per cent of the oranges produced in the State. Before the growers organized fruit was rotting on the ground for want of a market and people were talking over-production. This year the exchange shipped 24,217 cars of oranges and 5,565 cars of lemons, which returned about $19,537,850.00 to the growers of this State.

Two years ago raisins sold at 2 cents per pound, which was less than the cost of production. The raisin association started at that time has, in spite of a tremendous increase in production, raised the price to about 4 cents paid this year.

The almond growers have had a strong association for some time, and the peach growers and olive growers have profited by the example and this year have organized state-wide associations.

The California Walnut Growers' Association is also a fine example of what growers can do for themselves through co-operation. This association has control of about 80 per cent of the walnuts in the State, and each year sets the price at which walnuts will sell. They wait until the crop is almost ready to harvest before setting this price, and get very accurate estimates of the crop here as well as in all other countries where walnuts are raised. They take into consideration the financial conditions of the country. They know what it costs to produce a walnut and what it costs to sell it. Taking all these things into careful consideration, they set a price which will give the growers a fair profit and yet one that will enable them to sell the nuts promptly.

If the dried apricot growers were as strongly organized they would have still more control over the market, as apricots are not grown commercially outside of this State. Large quantities of walnuts are imported each year while apricots are exported.

The producer of dried apricots is in virtually the same position as a manufacturer and should be able to set a price on his product which will return a profit. No manufacturer would sell his product without adding a profit above the cost of production.

WHY PRESENT DRIED APRICOT ASSOCIATIONS ARE NOT MORE SUCCESSFUL.

The reason that so many dried apricot associations have failed, and that the present associations are not more successful, is largely because only small districts have organized and have not been strong enough to stand the powerful competition of the great packing concerns in the State, who have been making enormous profit out of the business and have plenty of capital to exert every known means to put the small co-operative dried fruit association out of business and keep the business in their own hands. They have many ways of accomplishing this end, chief among which is to pay very high prices in territory where associations exist to the growers who are not members of the association. This, of course, makes short sighted growers withdraw from the association

and the association does not last long. In this connection allow me to refer to G. Harold Powell's "Fundamental Principles of Co-operation in Agriculture," which can be obtained free by writing for circular No. 123 to the University of California, Agricultural Experiment Station, at Berkeley. Every apricot grower should study this circular carefully.

Some of the dried fruit associations now in the State—about six of which handle largely apricots—through careful packing have created a good demand for their product, but as all of these associations put together probably do not control over 25 per cent of the crop it will be easily seen that they have practically no control over prices.

Another great reason why associations have failed is because they have not been able to make prompt payment to their members for their fruit. Some arrangement must be made whereby the grower can get at least 4 or 5 cents per pound for his crop upon delivery to the packing house before a dried apricot association can hold all of its members, because most apricot growers are poor and have to borrow money to meet the heavy expense of harvesting their crops, and can not be made satisfied to wait several months for their money. This will have to be accomplished by the apricot association being organized as a capital stock corporation and owning property so that they will be in a position where they can borrow money to meet this necessity. This has been one of the prime causes of failure among present associations. The raisin growers organized with a large capital and their manager, Mr. James Madison, attributes much of their success to this point of having good financial standing. The new peach growers' association has followed their example by capitalizing at $1,000,000.00. It is my opinion that a state-wide dried apricot association should organize with capital if it is to succeed.

With the walnut growers' association the nonprofit form of corporation works all right for they sell out their entire crop, usually within two months from harvest, and are able to make prompt payment to the growers. Walnuts are largely consumed during the holidays while dried fruits are eaten more heavily in late spring, and this is the reason sales are slower on apricots.

SUGGESTION OF BEST PLAN OF ORGANIZATION.

The new apricot association should then be state-wide, and have not less than 60 per cent of the apricots under its control. Perhaps if growers could be allowed to sign a preliminary paper which would not pledge them to become members unless 60 per cent can be obtained a larger number of members could be secured.

The new association should be organized with a large capital stock, so that they can own all of their own packing houses, which will give them good financial standing and enable them to borrow the money necessary to make a prompt payment to their members. All of the capital stock should be owned by the growers in proportion to their acreage, and arrangement should be made so that this stock can never get out of growers' hands. Perhaps five dollars per acre would be enough to start with.

Perhaps it would be well to organize in districts as the olive growers are doing. The acreage of apricots in the State is scattered about as follows, and each section might be considered as a district: Bay region, 17.289 acres; southern California, 16,615 acres; Sacramento Valley, 5,856 acres; San Joaquin Valley, 2,820 acres.

I believe the southern California district already has plans for organization. Who will undertake the work in the other districts?

WHAT CAN BE ACCOMPLISHED.

One of the most important things to be accomplished is to increase the consumption of dried apricots, especially in the United States. The best method of doing this is to pack the fruit in small one and two pound, attractive pasteboard cartons, which would take the fruit direct to the consumer in a clean, sanitary manner and take the *Association brand* with it. This method of packing, together with consistent advertising, would greatly increase the consumption of dried apricots in this country. Raisins and figs have been put up this way for many years. This year even the California Walnut Growers' Association has adopted a one pound package for its walnuts, mainly as an advertising scheme, and the results are very satisfactory. Such a method of packing is far more necessary for dried apricots than for walnuts, for, besides the advertising feature, it would bring the product in a clean attractive form and a guaranteed quality to the consumer, whereas, under the present method of packing in large wooden boxes the dried fruit remains open in the retail store for weeks, sometimes, and becomes dusty, dried up and perhaps wormy before it reaches the consumer.

It has been proven by experiments of William B. Parker, published in bulletin No. 235, United States Department of Agriculture, that dried apricots may be sterilized and put in moth-proof paper lined cartons and kept for years without becoming wormy. This method has been used for cereals for some time. To guarantee their fruit free from worms would be a great feature for the new association, for nothing can hurt the sale of fruit more than to have it wormy.

They could save the growers much in the purchase of tray and box materials, also sulphur.

They could encourage the growing of better fruit in many ways, especially by inspection and improvement of drying ground methods.

They could handle their own pits at a good profit.

In fact, a state-wide dried apricot association is a necessity. I think we all realize this. Who will put his hand to the wheel and help get it started? There is no time like the present.

SUBTROPICAL FRUITS FOR CALIFORNIA.*

By David L. Crawford, Professor of Botany, Pomona College, Claremont, Cal.

California is sufficiently subtropical to have been for many years undisputed world leader in the production of citrus fruits, which distinctly are natives of the tropics and subtropics. And now our attention is being drawn more and more forcibly toward the production here of other subtropical and southern fruits. Many of our fruit growers are sure that some of these newer introductions will, before long, prove to be more lucrative than the oranges and lemons. The fact is that certain of these fruits have, during the past few years, been grown so successfully in California that the problem is no longer the adaptation of the crops to this climate and soil, but the marketing of the fruits on a sufficiently large scale to warrant their being grown extensively.

Of all the vast array of tropical and subtropical fruits which are being produced in various parts of the world and heralded so widely in the agricultural press of today, only a few will be worth the effort to make them a commercial success in this State. Some others can be, and perhaps are being, grown to a limited extent in restricted areas, or under special conditions of protection from cold and dryness; and still others may be successfully grown but will never command a market which will pay for the production; for we must remember that we have at present a large number of good temperate fruits which supply our needs very satisfactorily, and a new tropical fruit can not be established commercially unless there is a distinct need for it—either to replace one of the already established fruits or else to fill a demand never before met by our northern fruits. A traveler goes through the tropics and eats many delicious fruits which he never saw before, but he relishes them, not because they are better than apples and peaches and grapes, but because they are the only fruits he gets. He comes back to this country all fired with enthusiasm for introducing these fruits here, but he soon finds that as long as our people have their apples and peaches and grapes they do not feel the need for additional southern fruits to replace the familiar kinds. The converse of this also is true. How much more does a Mexican relish a good mango or sapote than an imported peach or pear!

However, there are certain fruits of the tropics which northern people need. For ages past oranges and lemons have been in wide use by almost all races of men. Therefore, when it was discovered that they would grow well in California it was not necessary to create a demand in the markets, for it already existed. Bananas, also, and pineapples have for generations been as familiar as apples and melons, for they are in demand both because they fill a certain need in our diet, and more yet because they are cheap. Now, it is just so with a few other tropical fruits, although the American people have not yet recognized this fact. There are a few fruits, such as the Avocado, which ought to be used in our diet regularly in addition to our present list of fruits, for they supply a need not filled adequately by our fruits; and there are a few

*Address before State Fruit Growers' Convention, Palo Alto, Cal., July, 1915.

others, such as the Feijoa, which ought to supplant certain of our present fruits because the former can be produced more cheaply and better.

It will be the purpose of this paper, then, not to discuss the problems of growing the tropical fruits nor of marketing them, nor the introduction of new kinds more or less unknown now popularly, but simply to point out the few fruits which, in my estimation, will be a commercial success in this State; and to urge a greater activity in this industry.

There are two general types of tropical fruits—those that grow only in humid and warm lowlands and those that grow in the drier and cooler uplands of the southern countries. Because of the dryness of our atmosphere it is manifestly unreasonable to even attempt to grow here, commercially, such fruits of the first class as bananas, pineapples, papayas and certain sapotes. But of the second class there are several fruits which not only can be, but have been, grown successfully on a commercial scale—as successfully, in fact, as in the tropics. We shall confine our attention, therefore, to these latter and especially to those which give definite promise of being commercially important in our horticulture.

THE AVOCADO.

The avocado has come to stay, having already shown its adaptability to our climate and soils. Avocadoes are a necessary part of the Mexican's diet, just as butter is of ours, and it will be some day a regular part of ours, also. The problems of making this fruit a commercial success are several. First, there is the problem of determining what are the best varieties for this country, both from the standpoint of growing the fruit and of shipping it to market. This is being solved by wide trial and general experimenting.

A second problem lies in the securing of good trees to start with, even granting that we have decided upon the variety we intend to plant. Nursery trees cost too much and there are too many amateur and inexperienced and irresponsible individuals selling them. Growers should know that very much depends upon the quality and kind of bud used by the propagator, and they should be careful to buy only from one who has surely used good buds and good seedlings to put the buds into. We need a few good responsible nurserymen to propagate many first class avocado trees, which will have the name and reputation of an upright firm behind them; and they must offer these at a low price to increase the planting and to discourage the small and irresponsible propagator.

There is a third, and surely the largest, problem in the selling of the fruit and increasing the consumption. On the solving of this problem hangs the future of the avocado industry in California. The fruit is a luxury at present—and an exceedingly costly one at that—while it should be a commodity within the financial reach of the masses. Too much profit is desired by the grower at the outset and in his short-sighted greediness he is strangling the industry before it gets a fair establishment. Good avocadoes can be produced and sold at profit at 5 to 15 cents each, depending on the size of fruit and season of year, whereas now they are offered at 25 to 75 cents each. In 1912 I saw a shipment of less than 3,000 fine avocadoes enter San Francisco; because

they were offered for sale at 50 to 75 cents each that small number of fruits actually glutted the market and scarcely half were sold!

We need some Henry Fords in the avocado business to bring the fruit production and marketing to a sensible basis, whereby the masses can be enabled to know, and value, and use this most nutritious of all fruits. We must have cheaper nursery trees and cheaper fruit on the market, and then—and not until then—the people will use avocadoes and will buy them as freely as many of our other fruits. It is to be hoped that the new Ahuacate Growers' Association—how much better to have named it the Avocado Growers' Association—will attack this, their greatest problem, in some such way as suggested above. The problems of diseases and insect pests will be plenty, but not so serious as that immediately before us now—taking the avocado from the luxury list and making it a necessity.

THE MANGO.

The mango industry will never be so successful in this State as that of the avocado, for it is a fruit more closely adapted to the humid tropics and thus far has not been a marked success here. The trees grow fairly well here and withstand considerable cold weather, but are not able to ripen their fruit successfully, because the warm season is not quite long enough. Moreover, the fruit can be grown to perfection in nearby tropical countries and easily shipped into this country in sufficient quantity to supply our demand. I have eaten mangoes in California received from Manila, one month in transit!

There is promise of some success in the mango industry here, however, on another basis. Green mangoes can be made into the finest kind of sauce, much resembling apple sauce but superior in flavor. A mango tree is usually fully as prolific as an apple tree, and although it does not ripen its fruits well they can be used in this way to good advantage, even commercially.

Mangoes, however, correspond in the tropics to our peaches and plums—that is, they fill the same need in diet—and because we are well supplied with the two latter fruits and need no substitute, and because the mangoes do not thrive here as well as they should, it is very probable that this fruit will never be an important one in the horticulture of California.

THE GUAVA AND FEIJOA.

Next in importance to the avocado come these several closely related fruits, for they not only are being grown successfully in our State now, but they fill a very important need not wholly met by other fruits. We are familiar with the small strawberry guava and the excellent jam and jelly which is made from it. Much more valuable, however, are certain other species of guavas which yield larger fruit and in greater numbers. The lemon guava is especially valuable, since the trees become large and are very productive, while the fruits are as large as small lemons and very useful in jam and jelly making.

Special emphasis, however, must be given to the feijoa (*Feijoa sellowiana*), which is a close relative of the guava, has more or less the same flavor and more value as a fruit for commerce. This is a South American fruit, native to a country very similar in climate to our own. About twenty-five years ago a few cuttings were taken to France and

the plants thrived so well there that they were distributed into southern Europe and later into California and other parts of the southern United States. The oldest plants here have not been in production long enough to demonstrate the commercial success of this fruit, but several facts indicate strongly that it will soon become one of our important fruit crops: first, the fact that the plant thrives well in this climate and in most average soils, and produces abundantly after the age of about six years; second, the fruit is relatively hard and can stand shipment to a considerable distance; third, the fruit is very valuable as a food when made into a sauce or jam, being superior to guavas both in flavor and in having much smaller and therefore less troublesome seeds.

If the feijoa proves to be a complete success so far as the growing and bearing of fruit is concerned—and it seems to be—it will not be difficult to establish it in our markets. We are already familiar with the guavas and their values, and if feijoas are placed beside them in the market and sold as a new and superior type of guava they will very soon win as much favor as they deserve, and so become established. It will be a much simpler problem than introducing the avocado or mango to an extensive market in this country.

THE CHAYOTE, OR VEGETABLE PEAR.

Although the chayote is more a vegetable than a fruit, yet it is of such value that it deserves a very prominent place in a discussion of this sort. The fruit is about the size and, roughly, the shape of a large pear, and is solid throughout, with a large fleshy seed in the big end. The flavor somewhat resembles that of a turnip and is suggestive, also, of a summer squash, while the flesh is about as solid as that of a turnip. Boiled or fried it makes a very delicious and nutritious vegetable dish. The people of the American tropics relish the chayote very greatly and consider it one of the very important crops. But its value to us lies not only in its flavor and food value, but chiefly in the great productivity of the plants, whereby it may become one of the most remunerative of our vegetable crops, as well as one of the best. The plant is a climber, resembling a muskmelon or squash vine in appearance of foliage It is easily grown by planting a whole chayote, big end down or else on its flat side, so that the fruit is just barely covered with soil. A good supply of water makes its growth very rapid and extensive. Cheap trellises of some sort, such as are used for hop plants, are needed for the vines to climb on. Started in early spring the plant grows very extensively, and in the fall of the year produces from 100 to 200 or more fruits. An acre of ground planted with chayotes ought to yield more income than if planted with turnips, even if the former are sold at the same price as the latter.

This vegetable is so much liked by practically all who have tried it that I venture to affirm that there would be little risk of loss if a man were to grow several acres of this crop and offer them for sale in the open markets, or by peddlers at a reasonably low price. Properly advertised, they would sell as a novelty at first and then as a staple vegetable of considerable value. Without doubt this is one of the most promising of the subtropical vegetable crops for California, because it has been demonstrated that the plant thrives and produces remarkably well here. It remains now to establish it as a regular staple vegetable of commerce.

OTHER FRUITS.

We have considered very briefly a few of the most important of the tropical fruits for this State, but there are many more which deserve more than mere mention. Dates are surely a commercial success here and are destined to a very important place in our horticulture. These trees are best adapted to regions with a very long, dry and hot summer season, for they require much heat for ripening their fruit.

The edible passion fruits (*Passiflora* spp.) may become of some importance in a limited and local way, for in addition to furnishing a profusion of acid fruits with the flavor of apricots, the vines are very useful as ornaments. They are good climbers and make an excellent porch or arbor plant. In tropical countries the fruits are much used for flavoring soft drinks and sherbets and desserts. Most species of this genus of plants thrive excellently in this State.

The cherimoya (*Anona cherimoya*), and several related anonas, grow well here and fruit moderately well. The cherimoya is a fruit which, in the tropics, thrives to better advantage in the cooler highlands than in the lowlands, so it is not remarkable that it should do so well here. The fruit has a very peculiar flavor, by some considered delicious but by many others quite the contrary. Probably the best place the fruit will ever have in our commerce will be as an oddity and luxury, to be seen comparatively rarely on the table of the man of moderate means.

Several sapotes—especially the white variety—give promise of being about as prominent commercially as the cherimoya. This, also, is a fruit of peculiar flavor not always relished by an American, but is valuable as an oddity. The tree of the white sapote, when it is properly shaped and headed up in its younger stages of growth, makes a first-class ornament for gardens or parks, and for this object it is well worth growing.

The papaya (*Carica papaya*) is too much a tropical tree to be successful here. To fruit well and ripen its fruits properly it requires tropical warmth and humidity, and uniformity of temperature not prevalent in this State. However, as an ornamental plant it is highly valuable because of its tropical foliage and it has been found to grow moderately well in protected places here.

CONCLUSION.

In conclusion, let me emphasize again the fact that there are two types of tropical fruits, namely: those that can fill both an important and an unfilled need in our diet, and those that correspond in the tropical man's diet to our common northern fruits, such as apples, peaches, plums, etc. The latter type gives little promise of commercial success here, because such fruits can not displace our northern fruits; but the former type gives much promise of large success as a California industry, provided the problem of introduction and establishment in the markets is attacked in the right way. To place these fruits on the market as a luxury at a high price is a mistake, and if this is continued it will strangle the coming industry in its infancy.

We need enthusiasm in the spreading of this industry among the fruit growers of the State, but the enthusiasm must not be misdirected. We need, most of all, men who have enough foresight to cut off some of their present gain in order to establish the industry firmly and widely, and who will offer good nursery trees reasonably cheap, and good fruit to the consumer at a reasonably low price—to make these fruits an integral part of our diet.

THE MAINTENANCE OF SOIL FERTILITY.*

By W. P. KELLEY, University of California, Citrus Experiment Station, Riverside, Cal.

I shall confine myself to a brief discussion of some of the broader aspects of the question of soil maintenance, dwelling on what appears to me to be both essential to a permanent system of agriculture, and timely at the present stage of agricultural development in California. However, it is not my purpose to discuss the several details involved in the maintenance of a given farm. The specific rules for the best management of a given tract of land necessarily vary on different farms and can only be arrived at by actual experience on the farm in question. This fact, it seems to me, is often not sufficiently recognized, either by the farmer or many agricultural investigators. One of the commonest inquiries at the experiment stations has to do with the management and fertilization of a given soil and crop; but unfortunately it is seldom that definite answers can be given, for the reason that all the conditions and previous history of the soil are seldom given, and also because experimental experience has usually been insufficiently general to warrant definite conclusions. It is not quite certain, for example, whether ammonium sulfate or lime nitrate will always produce better effects, as an orchard fertilizer, than organic forms of nitrogen, or whether the extensive use of lime, as it is applied in the east, will or will not be profitable on many fruit farms of California.

Soil fertility has at different times been variously defined. The sense in which I shall use the term is that of the crop producing power; and I may state in passing that the crop producing power of a soil is a much larger question than merely the plant food involved, although the plant food is an important phase of the question. There are chemical, physical and biological factors involved, each of which is equally as fundamental as the plant food itself.

We have heard much during recent years of the abandoned farms of the east, and it is well known that unless the greatest care be taken, the time usually comes when the yields go down. The facts that virgin soils as a rule are fertile and that cultivated lands are likely to become less productive are generally recognized. Here in California we are cultivating a virgin soil, comparatively speaking; but in fruit culture, under artifical irrigation and perennially growing weather, we have a far more intensive system and one that certainly makes stronger demands on the soil than in the culture of field crops in the humid sections of the east. The methods employed in this State, however, do not differ in principle from those that have been followed during the earlier years of agriculture in older sections. The common system at the outset everywhere has been that of the continuous culture of a single crop.

The first essential to soil maintenance is that of maintaining the organic matter. The humus content of California soils is low and the nitrogen likewise low, but it is not so much the absolute amounts of humus in a soil that determine its fertility as the processes involved in the formation of humus. Under the climatic conditions prevailing here it is doubtful whether it will ever be found practicable to increase

*Address before State Fruit Growers' Convention, Palo Alto, Cal., July, 1915.

greatly the humus content. We have found at Riverside, for example, that the annual application of manure, coupled with plowing under a leguminous cover crop each year for the past eight years, has not resulted in any appreciable increase in the humus content of the soil. Yet it is obvious that the soil is in an improved condition as compared with the virgin soil alongside, and the trees show excellent vigor and thrift. Likewise at both the Pennsylvania and Indiana stations the frequent application of barnyard manure for thirty or more years has resulted in only a small increase in the humus content of the soil. Our soils would certainly be benefited by a larger humus supply, but the matter of increasing the actual humus is one of great difficulty and slowness; so from a practical standpoint it is not to be expected that great gains in the humus content can be obtained.

In any event, however, humus is the stable residue left behind after the bacterial decompositions have become arrested. It represents the more resistant and slowly decomposable organic residue that is formed from organic matter, cover crops and manure. We are coming to believe that it is the processes involved in the decomposition of fresh organic matter, the transitory products that are formed and the physical, chemical and biological effects produced, rather than the humus residue left behind, that constitute the great value derived from adding organic matter to soils. As one of the eastern experiment station men recently expressed the matter, "It is the current of organic matter flowing through the soil rather than the humus residue formed that constitutes the chief value of green manuring."

Following this line of reasoning it is easy to see why it is necessary to make frequent applications of organic matter. As Dean Hunt has said, the chief object in soil management should be to keep the soil virgin. It is well known that virgin soils generally contain more or less organic matter in a partially decomposed condition. In the state of nature the grasses, weeds and leaves fall and become incorporated with the soil, thus continually adding fresh supplies of organic matter. In its decomposition the soil is kept in the state we call virgin, and so far as soil organic matter is concerned the closer we imitate nature by frequent applications of organic matter, the better.

During recent years much effort and thought have been directed towards supplying deficiencies of the soil by the use of commercial fertilizers and, to some extent, of cover crops. It is outside my present purpose to discuss the wisdom of these practices further than to point out that cover cropping with a legume is fundamental to soil maintenance in fruit culture in California. In the larger aspects of the question, however, when we consider the soil of the State as a whole, the systems now being generally employed are only temporary so far as maintaining the soil is concerned; fertilizers have played, and certainly will continue to play, a prominent part; cover cropping and mulching are likewise valuable, but inherently the great agricultural need of California, both from the standpoint of soil maintenance and economic stability, is diversification.

At the present time only a small percentage of the arable land of California is devoted to fruit culture, and the use of organic materials and

manure, each of which is produced on lands not devoted to fruit culture, in the last analysis, robs these lands of fertility to which they are entitled. The system reminds us of the experiences of China, where the upper central tablelands have been largely denuded of vegetation and depleted of fertility by the leaching and eroding action of the streams which bring down silt and debris, depositing it on the lower lands. It is the lowlands of China along the river basins that are so fertile today, and not the uplands.

As stated above, this State needs diversification, and this has been the case at one time or another in almost every extensive agricultural section of the world. The fertility of the soils as a whole can not be maintained without it. Years ago the black prairie soil of Illinois was thought to be inexhaustible, but the continuous culture of corn reduced the crop producing powers until today crop rotation is coming to be generally practiced. Diversification and crop rotation are advantageous not alone because they contribute towards the distribution of chance and make stable markets, but because a higher type of soil maintenance is made possible than under any single crop system. The maintenance of humus in soils is an extremely difficult matter if the system employed be divorced from live stock farming. The use of farm manures lies at the very foundation of permanent soil maintenance, and in the east is considered a fundamental essential to the upkeep of the soil.

Imagine the security and stability of agriculture that would ensue in this State if, instead of there being large tracts of land devoted exclusively to grain or fruits, as at present, we had a type of mixed farming in which different crops, including fruits, grains and legumes, with live stock, were grown on each farm. With such a system the purchase of manure and straw would become largely unnecessary and the amounts of manure could be regulated according to the needs.

It has been said that about three generations of farmers are necessary to the development of a stable agriculture in any community, and it is certain that the fertility of virgin soils in many sections has been greatly reduced before a permanent system was evolved. We are likely to think that in fruit culture, commercial fertilizers can take the place of organic matter; but I venture to assert that such will hardly be found to be the case. In fact, there is no extensive area in any portion of the world on which a single cultivated crop has been produced continually without a reduction either in the fertility of the soil, or that of other lands near by. In Hawaii, for instance, the sugar growers thought for years that their yields could be maintained by fertilization, but the time has already arrived when the demand for fresh supplies of organic matter has been so keenly felt that today their greatest problem is concerning this matter. Much of the energy of their staff of scientists is being devoted to this problem. Their soils, however, contain much greater quantities of humus than California soils. In spite of this fact, fresh supplies greatly increase the yields. Much of the difficulty met with in the maintenance of our soils would be obviated by mixed farming, and greater economic stability would certainly result.

THE MONTHLY BULLETIN

CALIFORNIA STATE COMMISSION OF HORTICULTURE

DEVOTED TO HORTICULTURE IN ITS BROADEST SENSE, WITH SPECIAL REFERENCE TO PLANT DISEASES, INSECT PESTS, AND THEIR CONTROL.

Sent free to all citizens of the State of California. Offered in exchange for bulletins of the Federal Government and experiment stations, entomological and mycological journals, agricultural and horticultural papers, botanical and other publications of a similar nature.

A. J. COOK, State Commissioner of Horticulture------Censor
E. J. VOSLER, Secretary State Commission of Horticulture------Editor

ASSOCIATE EDITORS.

GEO. P. WELDON------Chief Deputy Commissioner
HARRY S. SMITH------Superintendent State Insectary
FREDERICK MASKEW------Chief Deputy Quarantine Officer

Entered as second class matter December 29, 1911, at the post office at Sacramento, California, under the act of July 16, 1894.

The Law Governing the Shipment of Plants and Plant Products by Parcel Post.—Two of the county horticultural commissioners have informed us that postmasters in their counties are not vigilant in obeying the law governing the shipment of plants and plant products by parcel post in forwarding such parcels to inspection centers, as the law directs. This new law adds three important functions to the duties of the county horticultural commissioner. It is necessary for him to inspect all of these shipments, and he may well act to acquaint the postmasters that all plants and plant products are to be inspected, and if the shipment arrives at a point that has not been designated an inspection center, it must then be sent to the nearest point where an inspector is located. All the postmasters have been informed regarding the inspection centers. Again, in case any postmaster is known to be remiss in his duty, the county horticultural commissioner, indeed, any person, will be doing the fruit growers and the State a signal service if such information is sent to Mr. A. M. Dockery, Third Assistant Postmaster General, Washington, D. C.—A. J. C.

Special Potato Convention, Placerville.—The first of the ten special potato conventions to be held this present winter occurred at Placerville December 29th. Messrs. Eugene Grugg, author and expert in potato culture, E. H. Phreaner and A. J. Cook, State Commissioner of Horticulture, addressed the meeting. The attendance was large, and the interest manifested was most encouraging. It was fortunate that the first meeting was held in El Dorado County, the home of Mr. Phreaner, who took the sweepstakes at the great exposition on his potatoes and the first prize of $100.00 for the most and best potatoes grown on one acre this past season. Mr. Phreaner is also one of the four or five potato growers in the State who have produced certified seed under the

excellent law passed by the recent legislature. It is interesting to know that five potato growers in El Dorado County have expressed their intention to grow certified seed the coming season, as many as entered the list in the whole State this past year. We can only hope that at each meeting as much interest will be shown, and that in the season of 1916 there will be tons of certified potato seed instead of bushels, enough to fill the demand, although we can hardly expect such a result. Certified seed under the law will not only prove a godsend to the potato industry, but it will swell the income of the producer, for sound seed has double or triple the value of that usually sold in the market. No one can afford to plant diseased potato seed, if sound seed is obtainable, I may say, at almost any price.—A. J. C.

The Woolly Aphis on Pear.—The woolly aphis problem has become of so much importance that we are publishing the following letter sent to the county horticultural commissioners for the sake of giving the matter further publicity:

December 15, 1915.

DEAR SIR: Your attention is called to the fact that the woolly or root aphis of the pear is an extremely destructive pest in many of the better pear growing sections of the State, having been found plentifully in eleven counties. In several of these counties it is rated as the worst insect pest that occurs on this fruit. It is now thought to be an entirely different species than the common woolly louse of the apple, and its habits of attack certainly bear out this contention. It is seldom seen above the ground on pear trees, while the habit of the apple species is to attack both root and branches. Inspection to detect its presence on pear must therefore be made of the root system, and the greatest care is necessary.

As the occurrence of this insect is general, we would urge the most careful inspection of pear nursery stock, both at points of shipment and delivery within your county, and wish to lay special emphasis upon the *necessity for detecting it at the nursery while stock is being dug, and insisting upon treatment before trees are shipped.*

Fumigation with hydrocyanic acid gas in a tight box or house, using 1 ounce of potassium cyanide, 1 fluid ounce of sulphuric acid and 3 fluid ounces of water to every 100 cubic feet of space, exposing the trees to the gas for 45 minutes is recommended as an effective treatment which will not injure the trees. Sodium cyanide may be substituted for the potassium, using 1 ounce to 1½ fluid ounces sulphuric acid and 2 ounces water. Instead of fumigation "Black Leaf 40," 1 part to 800 parts of water, combined with either whale oil soap, 5 pounds or more to 100 gallons of water, or 1 per cent distillate emulsion, may be used. This mixture may be applied either as a spray or dip. If sprayed upon the trees a heavy pressure and nozzle giving a driving spray should be used, and the greatest care would be necessary to treat every portion of the root system in particular; and as an additional safeguard the tops should be sprayed also. If dipping instead of spraying is the method employed, roots should be immersed long enough to allow liquid to penetrate; fifteen minutes has been recommended by some. As this long immersion entails extra work and loss of time, it is suggested that a heavy sousing be given by violently forcing the roots through the liquid for a number of times.

The State office has been urged to help with the problem, and fully realizing its importance is asking your careful attention to the matter discussed in this letter.

Very truly yours,

A. J. COOK,

State Commissioner of Horticulture.

Green Spot of Orange.—In the September, 1915, number of The Monthly Bulletin may be found an article by Professor H. S. Fawcett, entitled "Spotting of Citrus Fruits." This article gives the results of experimental work proving that the oil from the rind coming in contact with the surface of the fruit produces the characteristic spotting. Recently the subject of spotting has received considerable attention by growers and packers in the Fair Oaks section, who noticed a very general injury to oranges picked early in the season, and there was much speculation as to the cause.

Some experimental work by Mr. E. J. Vosier and the writer gave exactly the same results as that done by Professor Fawcett. The accompanying illustration shows the result of placing some oil from

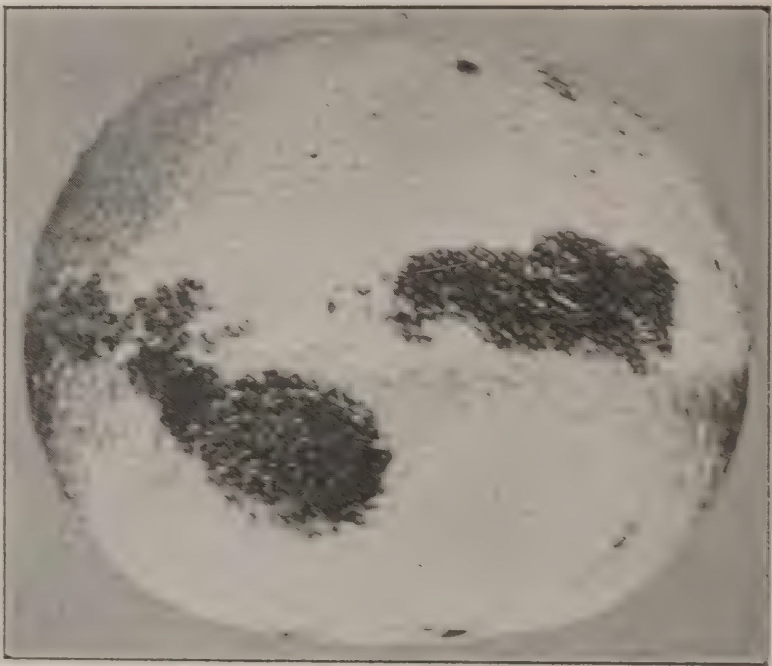

FIG. 14.—Green spot produced on orange by smearing the oil from the peel of another orange on the surface of the fruit when green. (Original.)

another orange on the surface of a fruit without bruising in the least. This orange, after being treated, was placed on a shelf in the laboratory and the typical spot developed within twenty-four hours. In this case there was no moisture present except that of the ordinary steam-heated room. A half dozen fruits treated all developed typical cases.

It is interesting to note that experiments conducted in a grove at Fair Oaks, to determine the effect of the oil upon oranges before being picked, proved that the same injury would result but not to quite so severe a degree. Some fruit treated on the south side of a tree where the oil rapidly evaporated caused no injury, while on the north side several typical cases resulted.

The fact that injury may occur to fruit on the trees makes it doubly advisable to prune in such a way as to avoid all possible bruising of the fruit, before picking, from winds, etc., for such bruising may result in the liberation of oil and consequent spotting.—G. P. W.

A Timely Bulletin.—Professor H. S. Fawcett has placed us under renewed obligation to him in preparing Bulletin No. 262, University of California. This brochure compares citrus troubles—fungoid, bacterial, physiological and insect ravages of citrus trees—in California with those of Florida, Cuba and Isle of Pines. We are pleased to note that we are free of many serious ills that our Gulf coast neighbors are called on to fight. No doubt, our efficient quarantine service is largely responsible for this happy riddance. Our strict quarantine has doubtless saved us from stem-end rot, another stage of Melanose, which Professor Fawcett declares to be the most common and troublesome rot of citrus fruit in Florida next to blue and green mould. In speaking of citrus canker the statement is made that it is by far the worst disease that has ever yet affected the citrus industry. We are interested to learn that this scourge is bacterial rather than fungous, as has generally been claimed.

The bulletin contains on the closing pages very instructive tables comparing insects and diseases on citrus trees in California, Florida, and Cuba, respectively. We summarize as follows:

CITRUS INSECT PESTS OF CALIFORNIA, FLORIDA, AND CUBA.

	Total number of insects reported	Important insects	Insects important at times or in few localities	Insects unimportant	Insects not known to occur
California	26	8	9	3	6
Florida	34	7	14	10	3
Cuba	25	11	6	4	4
Florida pests not found in California	----------	2	8	5	----------
Cuban pests not found in California	----------	5	4	----------	1

DISEASES OF CITRUS TREES IN CALIFORNIA, FLORIDA, AND CUBA.

	Total number of diseases reported	Number of diseases found in Florida and not in California	Number of diseases found in Cuba and not in California
California	29	----------	----------
Florida	28	13	----------
Cuba	24	----------	9

Total diseases not found in California, 22.

These tables emphasize strikingly the need of a well equipped and efficient quarantine service.—A. J. C.

Interesting Experiments.—In Bulletin No. 273 of the Department of Agriculture, on the dispersion of gypsy moth larvæ or caterpillars by wind, some surprising facts are recorded. Tanglefoot traps were

used in the experiments. In one case 289 freshly hatched caterpillars were caught on a surface of 977 square feet the larvæ having been carried by wind from one-eighth of a mile to over one mile. In another capture 346 caterpillars were caught on the sticky surface of 1,614 square feet, blown a distance of from one-eighth of a mile to thirteen and one-half miles.

It will be remembered that similar experiments were tried by County Commissioner H. P. Stabler, to ascertain the effect of wind in spreading the wee mites (red spiders). It goes without saying that we must take account of the action of wind in insect dispersion. This argues forcibly for community action in fighting our insect pests. Is not a neglectful neighborhood really a nuisance?—A. J. C.

THE MEXICAN BEAN WEEVIL.

By Edw. O. Amundsen.

A Mexican bean known as "Guamuchile" (pronounced wha-moo-chile), is often found infested by a weevil, *Bruchus limbatus*. Fig. 15.

The bean is "hot," as indicated by the ending, "chile." It is flat, hard, black and glossy, measures about three-eighths of an inch in diameter, and is rather irregularly shaped (Fig. 16). The bean is completely enveloped in a yellowish, oily pulp which is eaten raw by the natives with evident relish. This covering of pulp is shown in Fig. 16.

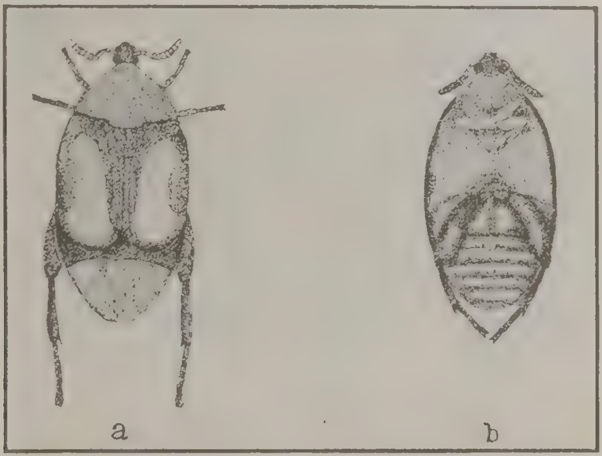

Fig. 15.—The Mexican bean weevil, *Bruchus limbatus*; a, dorsal view; b, ventral view. Nine times enlarged. (Original.)

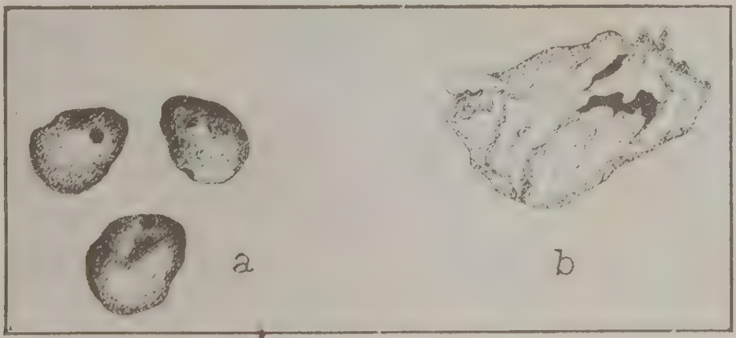

Fig. 16.—The Guamuchile bean: a, infested beans removed from the pulp; b, showing the oily, yellowish pulp which envelops the bean. Natural size. (Original.)

The pulp-covered beans are borne in pods, which are four to six inches long, five to eight beans in a pod. (Fig. 17.)

The weevil, *Bruchus limbatus*, is found in seeds of other legumes and, if unchecked, renders them unfit for food or seed. Even though the weevils are killed, the embryo of the seed is in many cases devoured by the larva and consequently does not germinate.

LIFE HISTORY.

The eggs are laid upon the pods while the latter are quite small. The larvæ, shortly after hatching, bore into the pods and into the beans. The hole in the growing bean soon closes up with the larva inside and

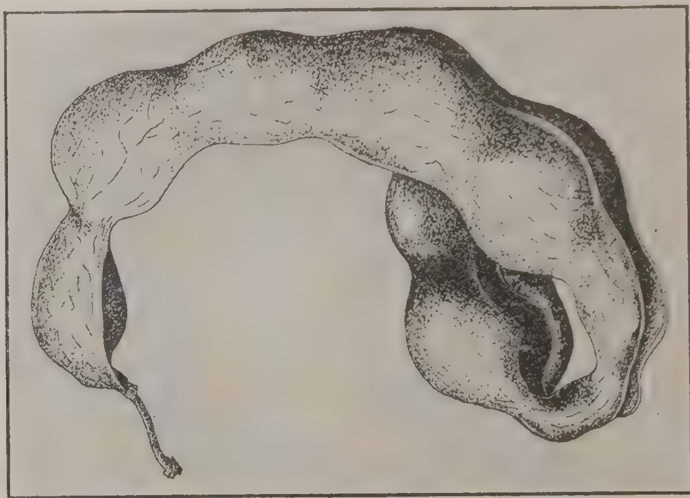

FIG. 17.—The pod of the Guamuchile bean. Slightly reduced. (Original.)

continuing to feed. Just before going into the pupal stage the larva eats its way up to the outer membrane of the bean, leaving just a thin circular pellicle in such shape that the adult can easily push it out when emerging.

The larva is a white grub, one-fifth of an inch long.

The pupa is that of a typical Bruchid.

CONTROL.

Fumigation with carbon bisulphide is generally recognized as the best treatment for the infested beans. It seems impossible to prevent the oviposition of eggs in the pods while in the field. It may be suggested that the following method will help to abate the nuisance: Disinfect all beans before planting in a closed container, using one pound to 1,000 cubic feet of space. Do not seed in soil which had beans on it the previous year.

Unless the weevils are destroyed very soon after the crop is gathered, they riddle the beans and finally leave practically nothing but the covering.

SOME NOTES ON THE CATALINA CHERRY MOTH.

By E. J. Branigan.

While doing some field work for the State Insectary in Los Angeles County last August, I came across some fruit of the Catalina cherry (*Prunus integrifolia*) at Sierra Madre, badly infested with the larvæ of a moth very much resembling the codling moth. Adults were reared and later sent to Dr. A. L. Quaintance of the Bureau of Entomology in Washington, who determined them as *Mellissopus latiferreana* Walsingham.

The adult in size and appearance is very similar to the codling moth. It differs, however, in color, being a dusky terra cotta, while the two marks on the wings are brown, with bronze reflections.

The eggs resemble those of the codling moth in color, size and general appearance, and are laid on the fruit.

The larvæ are also like those of the codling moth, excepting in color. They are a very light shade of pink when fully matured, the earlier stages being a dusky white.

Fig. 18.—The adult of the Catalina cherry moth, *Mellissopus latiferreana* Walsingham, on cherry. About natural size. (Photo by Harold Compere.)

The insect pupates in the ground just at the surface. The cocoon is made of silk, with an outside coating of pebbles and sand. The pupa itself is at first a light yellow, but with age turns to a dark brown. Like the codling moth, this insect passes the winter in the larval stage within the cocoon.

I collected one cocoon, which contains the small white cocoons of a Microgasterine parasite. The adults, however, had emerged.

The infestation was very heavy. The larva works both in the meat of the fruit and within the seed itself, which is comparatively very large, occupying three-fourths of the inside of the cherry. The cherry

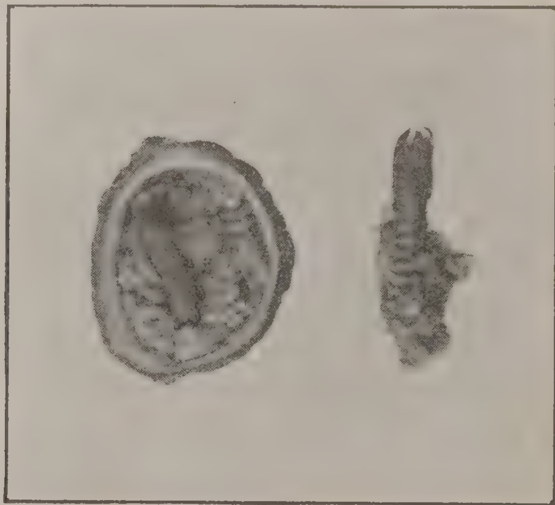

FIG. 19.—The larva of the Catalina cherry moth in the meat of the cherry, also showing the pupal skin of this species. About natural size. (Photo by Harold Compere.)

averages about the size of the cultivated species of cherry. The larva seems to have a preference for the seed, the shell of which is not very hard.

The distribution is said to be from Maine to California.

CALENDAR OF INSECT PESTS AND PLANT DISEASES.

By E. J. Vosler.

[Under the above heading the author aims to give brief, popular descriptions and methods of controlling insect pests and plant diseases as nearly as possible just prior to or at the time when the suggestions given should be carried into effect by the growers.]

The Peach Twig Borer.

The principal hosts of the peach twig borer are the peach, plum, apricot and the almond. The larvæ of this insect bore into the young buds and tender shoots, and later on enter the fruit at the stem end,

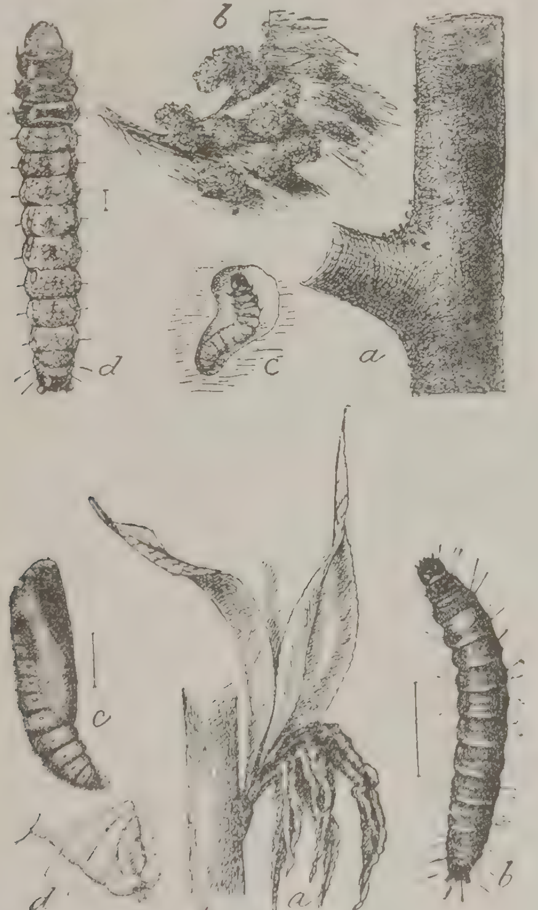

Fig. 20.—The peach twig borer. Top: a, limb showing location of the hibernating quarters; b, chimneys thrown up in constructing the hibernating quarters, enlarged; c, larva in its quarters; d, larva enlarged. Bottom: a, young shoot killed by the larva; b, larva; c, pupa; d, posterior tip of pupa. Lines show natural sizes. (After Marlatt, U. S. Dept. Agric.)

often completely encircling the pit and rendering the fruit unsalable. The worm that is found so commonly boring into the hulls of almonds while still on the tree is the larva of the twig borer.

The larva or worm varies in color from a dusky white to a brown, the head and the first three segments being of a blackish color. It is about one-half inch in length when full grown.

The life history of the peach twig borer is in brief as follows: The insect passes the winter in minute burrows made in the bark and located principally in the crotches of the limbs. Tiny silken tubes, covered with chewed bark, project upwards from the burrows, and the extent of the infestation can be determined by the number of these tubes. In the early spring the larvæ come out to feed on the tender shoots. They become full grown about May, passing the resting stage in crotches in the bark. The adults emerge about one week after pupation.

The use of a commercial preparation of lime-sulphur, diluted one part to ten parts of water, just before the buds are opening, will give

FIG. 21.—Apples disfigured by the attacks of the purple apple aphis when the fruit was young. These were picked at harvest time. Reduced one-half. (After Essig, Injurious and Beneficial Insects of Cal. Supplement to the Mo. Bul. Cal. Hort. Comm., Vol. IV, No. 4.)

excellent results. This solution already prepared can be obtained from the various insecticide dealers. This spray will not only control the twig borer, but also peach leaf curl, and several other diseases.

The Purple and the Green Aphides.

Two important plant lice working upon young apple shoots are the purple and the green aphides. The young fruits are discolored and the leaves curled by the attack of these lice. The former species causes the fruit to assume all sorts of abnormal shapes as well as checking its growth so that it does not attain to commercial size. The winter is passed in the egg stage, and eggs being deposited on twigs in the fall. P. R. Jones,* in a preliminary report on spraying the eggs of these

*Monthly Bulletin, Cal. Hort. Comm., Vol. 4. No. 1, page 20.

aphides, recommends spraying the trees, just before the buds start to show green, with commercial crude oil emulsion, one part to nine parts of water or one part to ten parts of water (when the concentrate contains about 85 per cent of crude oil); home-made crude oil emulsion from 10 to 15 per cent strength, made from a crude oil running from 19 degrees to 23 degrees Baumé; commercial lime-sulphur solution, one part to six parts of water. The distillate oil emulsion, if used, should be made of heavy distillate, so diluted that the material when sprayed on the trees will run from 7 to 8 per cent oil.

MISCELLANEOUS.

The Potato Eelworm.

About 500 species of plants are known to be subject to the attack of the eelworm. In this list we find fruit trees, almost all of our vegetables, clover, alfalfa and many of our common weeds.

The adult female eelworm, which is whitish or darkish in color, is flask shaped, and is about 1/25 inch in length. The adult male is spindle shaped, and is much smaller than the female. The illustration shows the effect of eelworm attack on potatoes. If a tuber is cut across the location of the colonies will be visible as small dark spots, just inside the peel. The surface of a badly infested eelworm potato is uneven or wart-like. These colonies are seldom more than ¼ inch under the surface of a potato. Infested tubers are unfit for seed and should be rigorously excluded.

No practical means of control are known. Rotation of crops, not subject to the attack of the eelworm, should be practiced.

PLANT DISEASES.

What Are Fungi?

The organisms known as fungi belong to the lowest forms of plant life, and among the fungi are some of the most important enemies of our fruit trees. Examples of destructive fungi are peach blight, peach leaf curl, potato scab, gummosis of citrus trees, shot-hole fungi, apricot rust, toadstools, and brown rot of stone fruits.

A fungus consists generally of a mass of branching filaments, which penetrate the tissues of the host from which it obtains its nourishment. It may secrete a poisonous substance, which will cause that part of the host attacked to die, or to become destroyed. From the filaments or mycelium the reproductive structures are formed at certain times, these giving off spores which spread the disease to other plants, the carrying agencies being wind, water, animals, etc. It is to kill these spores that we spray, so that we may check the disease before the spores germinate and enter the host. Spraying will not be effective after the filaments have entered the host.

There are thousands of species of fungi, and their study must necessarily be a big item to the orchardist. He should procure a work on fungos diseases and become familiar with them in a general way, in order to treat them intelligently.

FIG. 22.—Potatoes showing the work of the common nematode or potato eelworm. The section shows the colonies of the eelworms in the tubers. (After Essig, Injurious and Beneficial Insects of Cal., Supplement to the Mo. Bul. Cal. Hort. Comm., Vol. IV, No. 4.)

PLANT DISEASES.

Peach Blight.

A very common destructive disease of the peach and almond in California is the fungus causing the peach blight.

The effect of this fungus is to produce a shot-hole effect on the leaves, to kill the fruit buds, spot the young twigs, to cause the fruit to drop and, in a general way, to retard the development of the trees. Gumming usually accompanies an attack by this fungus.

FIG. 23.—Germinating spores of the fungus causing the black rot of the navel orange. The long thread-like filament sent out from each spore is known as the mycelium of the fungus. (After Amundsen, Mo. Bul. Cal. Hort. Comm., Vol. 2.)

The second spraying for its control should be applied just before the buds open in the spring, the first having been made in the fall. Use lime-sulphur solution, home-made or commercial. Dilute according to the strength of solution, which can be determined with a Baumé hydrometer. A table of dilutions may be found on page 557 of the December Monthly Bulletin. The ordinary commercial lime-sulphur runs about 33 degrees Baumé, and should be applied, one part to nine parts of water. The concentrated lime-sulphur can be purchased from any insecticide dealer. Spraying followed by rain within twenty-four hours should be repeated. The second spraying will also control peach twig borer, and leaf curl, another disease of the peach, if properly applied. Thoroughness in spraying, as well as in other orchard work, pays well.

Peach Leaf Curl.

Leaf curl is another fungous enemy of the peach. It has a wide distribution in California.

Duggar* gives the symptoms of leaf curl attack as follows:

> "The idea generally prevails that the leaf curl occurs only upon leaves and young branches, but the flowers and young fruit are likewise subject to attack. Since in the latter case the deformations are less conspicuous, and dropping of the parts affected is more prompt, it has often escaped attention. Leaves of the peach

Fig. 24.—Peach tree showing the effects of a bad attack of curl leaf. (After Weeks, Mo. Bul. Cal. Hort. Comm., Vol. I, No. 8.)

> affected by this fungus may be detected as soon as the leaf buds have become slightly unfolded. The coloring of the young leaves is somewhat heightened, and as they unfold a curling and arching of the blades becomes prominent. The distortion may be confined to a small area on one leaf as one extreme, or it may occur on all leaves and petioles, as well as on the young stem which bears these. As the leaves mature the green or reddish color is lost and the hypertrophied areas become pale in color. Further changes in the external appearance have been noted in a gray or mealy appearance of the surface, which occurs as a result of the production of the fungus superficially. Later the affected leaves turn brown and are finally defoliated. When defoliation is extensive the fruit crop

*Fungous diseases of plants.

will either be lost entirely or so stunted as to be of little value. Under favorable conditions a new crop of leaves will be promptly developed, but there is little or no evidence that this second crop of leaves may be affected even to a very limited extent. Gummy exudations sometimes appear on the enlarged twigs, particularly when the enlargement is not terminal. In case the terminal bud is not affected it may continue to grow later in the season, thus leaving the injured or swollen portion at the base of the new growth. It was formerly supposed that this fungus was very largely propagated by a perennating mycelium, or by infections resulting during the summer and persisting in the woody parts until the following season, but * * * infections must generally occur as the buds unfold. The percentage resulting from a mycelium remaining alive in the hypertrophied twigs is very small. The badly affected twig dies and the mycelium with it. From other affected twigs diseased leaf buds are seldom produced."

As the fungus works within the tissues where no fungicide can destroy it, and as infection in the spring results from the spores which have been caught in the bud scales, spraying should be performed before the spores germinate and the filaments of the fungus penetrate the tissues of the host. This time is just before the opening of the buds and lime-sulphur solution, one to ten of water, sprayed thoroughly on the trees, will control it effectively. As stated before, this spraying will control the brown mite to a certain extent, blight, shot-hole fungus and twig borer.

Fusarium Wilt of the Potato.

The Fusarium causes a decay of the stems and tubers. The potato grower can determine whether his potato seed is affected by cutting off the tubers near the stem end. If diseased there will be a brown ring just inside the peel. Do not plant affected tubers, as there will be much loss in the yield. Plant clean seed in clean soil. Rotation is important, as the fungus will live over in the soil. Seed can not be treated for this disease, so it must be carefully selected.

Potato Scab.

One of the potato diseases which is an important factor in the reduction of a good crop is the scab fungus. It causes a scabby appearance on the surface of the tuber, thus injuring the commercial value of the product, as well as cutting down yield. Soil in which scabby potatoes have been produced should be planted to some other crop for several years, as the fungus will live over in the soil and reinfest the tubers, even if care has been taken to plant disease-free seed. Plant in clean soil and treat all seed for one hour in a solution made by dissolving four ounces of corrosive sublimate in thirty gallons of water.

QUARANTINE DIVISION.

Report for the Month of November, 1915.

By Frederick Maskew.

SAN FRANCISCO STATION.

Steamship and baggage inspection:

Ships inspected	75
Passengers arriving from fruit fly ports	3,063

Horticultural imports:

	Parcels
Passed as free from pests	231,740
Fumigated	3,601
Refused admittance	175
Contraband destroyed	41
Total parcels horticultural imports for the month	235,557

Pests Intercepted.

From Belgium—

Aleyrodes sp. and larvæ of *Thrips* sp. on azaleas.
Coccus hesperidum, Aspidiotus britannicus and *Pseudococcus citrophilus* on bays.

From Fiji—

Pseudococcus sp. on cocoanut palms.

From Guatemala—

Cerataphis lataniæ, Pseudococcus sp., *Diaspis boisduvalii, Chrysomphalus aonidum* and *Coccus hesperidum* on orchids.

From Hawaii—

Pseudococcus bromeliæ and *Diaspis bromeliæ* on pineapples.
Coccus longulus on betel leaves.
Coccid on green cocoanuts.

From Japan—

Chionaspis citri and fungus on pomeloes.
Lepidopterous larvæ in chestnuts.
Aphis sp. on potted plant.

From Mexico—

Calandra oryzæ and *Bruchus* sp. in garbanzos.

From Pennsylvania—

Cerataphis lataniæ on palm.

From Tahiti—

Pseudococcus sp. on pineapples.
Larvæ of weevil in sweet potatoes.
Morganella maskelli on oranges.
Aphis sp., *Psylla* sp., *Aspidiotus* sp., and *Pseudococcus* sp. on potted plants

LOS ANGELES STATION.

Ships inspected	34

Horticultural imports:

	Parcels
Passed as free from pests	150,279½
Fumigated	2,271½
Refused admittance	10
Contraband destroyed	7
Total parcels horticultural imports for the month	152,568

Pests Intercepted.

From Belgium—

Aspidiotus hederæ on Kentia palms.
Coccus hesperidum on Dracena palms.
Coccus hesperidum on *Phœnix robelinia.*
Hemichionaspis aspidistræ on *Aspidistra lurida.*
Pseudococcus sp., *Coccus hesperidum*, *Aspidiotus britannicus* on bay trees.
Aleyrodes sp., Lepidopterous larvæ and cocoons on azaleas.

From Central America—

Pseudococcus sp. on bananas.

From Cuba—

Saissetia hemisphærica on cycads.

From Holland—

Lepidosaphes ulmi on Buxus.

From Idaho—

Codling moth larvæ on apples.
Rhizoctonia and scab on potatoes.

From Mexico—

Calandra sp. in garbanzos.
Chrysomphalus sp. on cocoanuts.

From New Jersey—

Chrysomphalus aonidum, *Cerataphis lataniæ*, *Chrysomphalus scutiformis* and *Pseudococcus* sp. on orchids.

From New York—

Pseudococcus sp. on Cape jessamine.

From Ohio—

Aspidiotus perniciosus on apples.

From San Salvador—

Howardia biclavis on *Aguacata amis.*

From Venezuela—

Chrysomphalus dictyospermi and *Diaspis boisduvalii* on orchids.

From Washington—

Cydia pomonella on apples.

SAN DIEGO STATION.

Steamship and baggage inspection:

Ships inspected	23
Fish boats inspected	51
Passengers arriving from fruit fly ports	39

Horticultural imports:

	Parcels
Passed as free from pests	10,232¼
Fumigated	2¼
Refused admittance	2½
Contraband destroyed	3
Total parcels horticultural imports for the month	10,240

Pests Intercepted.

From Iowa—

Crown gall on nursery stock.

From Mexico—

Lepidosaphes beckii and *Lepidosaphes gloverii* on oranges.
Drosophila sp. in cucumbers.

From New Jersey—

Pseudococcus longispinus on ferns.
Parlatoria pergandii on orchids.

EUREKA STATION.

Steamship and baggage inspection:

Ships inspected -- 5

Horticultural imports:

	Plants
	20,302

SANTA BARBARA STATION.

Steamship and baggage inspection:

Ships inspected -- 2
No horticultural imports.

PROGRAM

Forty-eighth California State Fruit Growers' Convention

THE MONTHLY BULLETIN

CALIFORNIA STATE COMMISSION OF HORTICULTURE.

Vol. V. February, 1916. No. 2.

THE WILL AND THE WAY.

By Frederick Maskew.

All members of the Horticultural Quarantine Service of the State of California have been and are using their best efforts in every direction to bring about the successful consummation of the legislation now before congress designed to furnish federal action and federal money for the

Fig. 25.—Florida grapefruit infected with *Phomopsis citri*, taken by the quarantine officers at San Francisco, January 5, 1915. (Photo by L. A. Whitney.)

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eradication of Citrus Canker from Florida and other states of the United States. The writer, who has been active in spreading this propaganda, has predicated his arguments in support of the same on the perhaps selfish grounds that so long as a case of this disease existed in the United States it would always remain a source of potential danger to the present clean citrus orchards of California. In support of this theory we call the attention to every fruit grower in the State to the photograph herewith reproduced.

As the illustration clearly portrays, this is a box of Florida grown grapefruit in the original package, and the fruit infected with *Phomopsis citri* still in the original wrappers. Note the ingenious method employed to evade the regulations: Wrapped in many folds of brown paper; placed in a regulation trade apple box; nature of the contents "Northern Spy" plainly marked on the outside (as provided), and billed through Wells Fargo Express Company as "one box apples" by Pearson Ryan and Company, Portland, Oregon, to T. Pearson, San Francisco.

It would have been unction to our soul, as quarantine officers, to have proceeded to the extreme in this case, but like many others diligent in the service we have found the *law*—when you get the Simon-pure article cold-drawn by a prospective prosecutor— takes cognizance of many contingencies not apparent to a layman in the original language of the statute. Hence in this instance we must content ourselves and the service with giving publicity to those directly concerned in this deliberate attempt to violate the horticultural quarantine regulations of the State, and take comfort in the fact that while the will and the way were present the end as conceived was prevented.

BLIGHT-RESISTANT ROOTS—THE FIRST STEP TOWARD PEAR-BLIGHT CONTROL.*

By A. L. Wisker, Grass Valley, California.

California's experience with pear-blight (*Bacillus amylovorus*) during the past two years has again emphasized the relative inability of orchardists generally to control this most serious of all diseases to which the pear is subject, and once more compels attention to the imperative need of adopting every measure that tends toward its suppression.

When a single grower suffers a loss of $25,000 from blight in one season argument is unnecessary to show that the situation is serious—particularly in view of the fact that California's pear industry, according to the last census, produced more money than that of any other state in the Union, notwithstanding the fact that her nearest rival, New York, had 50 per cent more bearing trees, and in total number had just twice as many as California. Michigan is close behind this state in number of bearing trees and in total number, but the value of her crop was less

*Address before State Fruit Growers' Convention, Palo Alto, California, July 28, 1915.

than one-third the value of ours. The statistics of the industry for the three states are as follows:

State	Bearing trees	Total number	Bushels, 1910	Value
California	1,410,905	1,808,998	1,928,097	$1,660,963
New York	2,141,596	3,644,251	1,343,089	1,418,218
Michigan	1,136,151	1,760,082	666,023	535,771

Collectively these states produce nearly half the pears of the entire nation.

Assuredly these figures warrant the assertion that if it pays to fight pear blight in any part of the country it will pay doubly well to do so here, where the industry is more profitable than in either of the other states where production approaches that of California.

The absolute eradication of pear blight cannot be hoped for, but blight control is a reasonable and practical expectation. Splendid work is now being done by scientific and practical investigators in the study of both preventive and remedial measures. The first named appear to be of greatest promise and much research work is in progress to discover and to breed varieties of high quality which shall be strongly blight-resistant in root, in trunk, and in branch. It is along this line that eventual deliverance from blight will be found, but some years must elapse before horticulture can reap the benefit of the work now in hand. In the meantime blight problems will continue to arise, and it is the purpose of this paper to deal particularly with our present knowledge of blight-resistant roots, since the elimination of blight in the underground parts of trees must ever remain the first and most important step toward pear blight control.

Probably 80 per cent of all pear trees grown in the United States are either budded or grafted on seedlings of *Pyrus communis*, the wild pear of Europe, commonly called by nurserymen the French pear. This is the ideal root for the nurseryman, since it has perfect affinity for all the commercial varieties, is satisfactory to "work," and if propagation is done by budding a high percentage of buds "take" if the work is properly performed.

However, from the standpoint of the orchardist *Pyrus communis* has three serious faults: it root-suckers profusely from plow injuries, is subject to great injury from the root aphis, and is particularly susceptible to the bacteria of pear blight; more so, in fact, than any other root used in pear propagation. For these reasons the securing of a satisfactory substitute becomes a matter of great importance.

It is known that the pear can be grown on seedlings of the hawthorn and the mountain ash, yet very few have been thus propagated, and little is known of the behavior of trees thus produced. However, Dr. Bailey states that good dwarfs can be grown on the thorn and that there is reason to believe that some of the thorns will be preferable to quince stocks for dwarf pears in severe climates, while the mountain ash has been used where the soil is excessively sandy, and is believed to be fairly resistant to blight.

The pear may also be grown on apple roots. In such cases the root is somewhat blight-resistant, but the tree is short-lived and apparently no advantage is to be found in this direction. No satisfactory pear orchards have been produced on the apple, although top-worked trees sometimes bear well for a few years. At Colfax, in this State, such a tree has borne extra fine fruit for the past five years and is still thrifty.

The affinity of some varieties of pears for the quince is well known, and orchards of the dwarf trees thus produced are of commercial importance in some parts of the country. In the production of such trees the pear is budded on rooted quince cuttings. This root is considerably more blight-resistant than the French pear, and is probably the best root to use in rich soil that is excessively moist. While dwarf pears are not in general favor in California, it is quite probable that under certain conditions they are much to be preferred to standard trees. Stephen Harmeling, a successful grower of Washington, maintains that under suitable conditions they are more profitable, and it is conceded that they are infinitely easier to inspect and prune if an outbreak of blight occurs in the orchard. Many varieties must be double-worked when grown on quince, thus increasing the cost of trees; but the fact that dwarf pears bear young and yield heavily, with an improvement in quality and shape for certain varieties, and have a measurable degree of blight-resistance, entitles the quince root to more consideration than it has yet received in California.

Rooted cuttings of the European-Asiatic hybrid pears, such as Kieffer, Le Conte, Garber, and Smith, have been used to a limited extent, but results have been generally negative. Kieffer is the most promising of those named. Le Conte cuttings were advocated several years since by a few California horticulturists. Of Le Conte Professor Waite says: "It was used in general commercial propagation in the southeastern states. It has not, however, proved particularly suitable. Bartlett orchards * * * on these rooted cuttings have gone down with the blight very seriously in Virginia and Maryland." Personally I have little confidence in rooted cuttings of these hybrids, but think there is a most hopeful field for experiment in testing rooted cuttings of certain varieties of European blood that have shown practically complete immunity to blight.

We have now to consider the root that in the present state of our knowledge appears to present the greatest combination of advantages of any of the roots having blight-resistant qualities—the Japan pear, *Pyrus sinensis,* the wild pear of Asia. Some nurserymen mistakenly refer to this root as "blight-proof"; it is not, but it is strongly blight-resistant. There is no blight-proof root thus far known to horticulture.

The use of this root extends over a relatively short period, and it is a matter of regret that we have no authoritative literature bearing upon the subject in a broad way, and no knowledge of any scientific observations extending over a period sufficient to warrant our arriving at wholly definite conclusions. Because no such analytical study of the subject is available I have been compelled to weigh the opinions of numerous observers, both scientific and practical, and to interpret them in the light of my own personal experience, which in itself is too limited to allow me to reach positive convictions. On most points the views

of the various scientific observers harmonize and the following seem to be generally accepted as facts:

1. The Japan seedling is of vigorous habit, frequently making more thrifty growth than the French. (Professor Waite believes the Asiatic pear and its hybrids make better growth in the east than on the Pacific Coast.)

2. Japan seedlings in the nursery are much less subject to the leaf-blight fungus (*Entomosporium maculatum*) than French. (Watson,

FIG. 26.—Pear tree treated for pear blight. Entire side of trunk removed. (After Gammon, Mo. Bul. Cal. Hort. Com.)

the great seedling nurseryman, states that French seedlings will sometimes be completely defoliated by this disease when adjacent rows of Japan show no sign of infection and suffer no impairment of vigor.)

3. Japan roots have but little tendency to sucker. French roots sucker readily from plow injury, and blight-infection of such suckers speedily reaches the main roots of the tree.

4. The pear root aphis—the most serious insect enemy of the tree when grown on French roots—does comparatively little injury to the Japan root.

5. While Japan seedlings vary in their resistance to blight, as do the French, and show different degrees of resistance in different parts of the country, their average resistance is much greater than any other root now in use. This resistance has not been reduced to the terms of a mathematical ratio, but the difference is so great that it is believed to afford relative immunity to root blight in Pacific Coast orchards grown on Japan roots. Their blight-resistant quality is less pronounced in the New England states, and Professor Waite has observed considerable blight injury to Japan-root trees in New York. Their behavior in the south, southeast and southwest has been as satisfactory as on the Pacific Coast.

6. The Japan root will make vigorous growth with less soil moisture than the French. It should, therefore, prove particularly valuable in all irrigated districts—especially throughout the foothill section—and in all dry soils. Important districts in Nevada and Placer counties that have to pay high water rates, and certain districts that have no irrigation facilities, should adopt this root exclusively, since it not only is adapted to their dryer soils but is strongly resistant to their worst insect pest—the root louse—which in some localities is more to be feared than blight. This root is better adapted to dry, warm climates than the French but its behavior in extremely severe northern climates is yet to be learned.

The opinions of nurserymen differ widely as to the Japan root, and after extended correspondence I have concluded that the average nurseryman has made but little study of the subject. Prejudice, selfishness, and ignorance was reflected in a number of the answers. One California nurseryman, who had only French root trees to sell, stated that Japan roots dwarfed the growth—than which no statement could be farther from the truth.

It is generally believed that the affinity between the Japan root and some of the European varieties is less pronounced than that of the French, and some nurserymen claim that not so high a percentage of buds will "take" on the Japan stock, thus making the tree more expensive to propagate. One Washington nurseryman discarded the root for this reason, having no other criticism.

It will take several years of experimental work to conclusively determine these points. In our nursery at Grass Valley we have only worked Anjou, Bartlett, Comice and Forelle on Japan stocks, but our stand was satisfactory when the work was carefully done. In our work with the varieties mentioned it seems that Anjou has not "taken" quite as readily as the others, but that may be due to some cause not determined. Where the bud "takes" at all we find the union to be perfect and in every sense satisfactory. However, a Newcastle nursery is said to have had difficulty getting a satisfactory union, but that is a point upon which all nurserymen who replied to the question claim to have had no difficulty. Mr. Barnicott of Newcastle strongly endorses the Japan root

after several years' use in his nursery work, but California nurserymen generally have grown relatively few Japan-root trees.

Oregon nurserymen use Japan roots very largely and this stock is also in favor in Washington. It has been used for twenty-eight years by W. T. Hood & Co. of Richmond, Virginia. Other prominent nurserymen who have found the root satisfactory, are Stark Bros., Chase Nursery Co., Franklin Davis Nursery Co., William P. Stark, Skinner & Co., Shenandoah Nurseries, Oregon Nursery Co., Watson & Co., and Milton Nursery Co.

The Japan root probably has one serious disadvantage—under conditions of excessive soil saturation it may be injured by root rot. If pear orchards on blight-resistant roots are desired, in such soils it may be best to grow dwarf pears on quince roots. Notwithstanding this one disadvantage of Japan, and the fact that it may be a little more expensive to the nurseryman to propagate trees on this root, we have discarded the French root entirely in our nursery and will neither buy, sell, give away, nor plant in our own orchards, any trees on French roots. We believe the French root must go because of its many evil qualities. If more complete acquaintance with the Japan root should prove that it has serious faults, the next step in the direction of blight-resistant roots will be the propagation of trees on rooted cuttings of certain varieties of *Pyrus communis* blood that have shown wonderful immunity to blight. It will probably take ten years of experiment to bring about this substitution, but the orchardist of the present may feel positive assurance that the day of blight-resistant roots is now at hand, and may at least safeguard his orchard to this extent.

Grateful acknowledgement is made to Dr. Taylor, Professors Waite, Gould, Lewis, O'Gara, Hedrick and Reimer, all of whom have generously given information that has been of material assistance in the preparation of this paper.

WEED ERADICATION.

By O. W. Newman.

The time to plant spring crops has come. Before purchasing seed it should be thoroughly inspected for weed seeds, and tested for germination. This applies to *all* seeds. A merchant is just as apt to sell corn or beans which may be poor in vitality as to sell grain or alfalfa filled with weed seeds. Napa and yellow star thistle were introduced in grain and spread from Napa County over many northern counties.

SOW CLEAN SEED.

It will pay to buy the best seed on the market. Seed is not necessarily a bargain because it is cheap. Have a good representative sample of the prospective purchase tested, by the county horticultural commissioner or the farm adviser.

Rice growers especially should be very careful to sow clean seed. Experiences of the last few years have proved this at the cost of many thousands of dollars. Over 2,000 acres of California rice land have been abandoned because of the water grass, which was introduced in the rice seed.

Sow Clean Seed.—If we could impress the importance of this phrase on the farmer and rancher we would add thousands of dollars to the agricultural income of the State.

The sale of impure seed should be a misdemeanor, punishable by law. A bill relating to impure seed was introduced at the last two sessions of the legislature, but from lack of substantial backing it did not pass. Undoubtedly this same bill will be introduced at the next legislative session, and we hope that all county horticultural commissioners will support it.

Sow Clean Seed.—It is the surest means of preventing the spread of Johnson grass, Canada thistle, morning glory, Russian thistle, yellow star thistle, and water grass. It is sound sense, sound business, and will bring in sound cash. It will reduce the spread of pests we have, and keep out those we have not.

METHODS OF ERADICATION.

After the weeds are on the land it is important to know how to get rid of them.

Cultivation.—The first and most important means of eradication of any weed is cultivation. The first cultivation should come in the fall. The spring cultivation will then kill many weeds which germinate after the fall plowing. Cultivation at all times and wherever possible not only keeps down the weeds, but conserves the moisture by creating a mulch. Harrow grain after it has become well rooted. This has been tried repeatedly and found to be very practical. Wheat, barley, oats, Sudan grass and rye can easily be handled in this way. The weed seeds being a little slower to germinate than the grains, will be in just the right condition to be killed. Use a spike-toothed harrow with as many spikes as possible. Harrow corn before it gets too high and go in later with a hoe and cut out the weeds. The writer has grown corn and tomatoes with weeds and without, and has proved that greater yields can be had without the weeds. Weeds take just as much moisture and nourishment as the commercial crop, and pay nothing.

For the average farmer summer fallowing is not a paying practice. Of course there may be cases where it is the best thing to do, but in general summer fallowing is expensive and wasteful of land which could be growing a crop and accomplish weed killing at the same time.

Pasturing should be practised in place of fallowing. Fields should be turned into pasture once every four or five years. Several head of stock on a piece of land will remove all weeds except the grasses, which are the only plants able to withstand close cropping. The writer has seen sheep and goats turned into a pasture reduce plant growth to a minimum in a very short space of time. Pasturing is also a valuable phase of a good crop rotation, as it gives the land a rest, adds manure, and gives renewed vigor to the land. If the farmer is careful to feed his stock clean grain and clean hay he will not spread weeds through the manure.

Crop Rotation.—This form of weed eradication is most important. Not only is it a means of eliminating pests, but it is one of the very finest means of renewing soils which are not producing well. Land which is producing good crops is rarely found infested with weeds.

Crop rotation is becoming universally recognized as absolutely necessary. The rotations vary with local conditions, but in general a good rotation should cover at least four years and should provide at least one tilled crop, one of clover or alfalfa, and others depending on what the locality produces to best advantage.

For the eradication of special weed pests such as Bermuda grass, morning glory, yellow star thistle or water grass, crop rotation is invaluable. To get the best results from land covered with Bermuda grass or other troublesome grasses, attach a shear to the front of the plow, which will cut the rootstocks and top of the plant. Plow six to eight inches deep, turning the earth over clean. After harrowing rake together and destroy all the rootstocks possible. Sow the field to barley, rye, or some other thick shade crop. It is the shade, as much as anything else, that keeps the grass down. As soon as the grain is harvested plow again and seed to vetch or Melilotus clover for a winter cover crop.

In case of yellow star thistle the best crops to use are hoe crops. Plant the land to beets, beans, potatoes, corn or other valuable crops and cultivate with a peg-tooth harrow or cultivator as often as possible, going over the field with a hoe between times.

In all agricultural work, whether it be for weed eradication or other purposes, the word "thorough" should be the password. Half the trouble from our insect, fungous, and weed pests could be avoided if the farmers and orchardists would do their work thoroughly.

ERADICATION OF SPECIAL WEEDS.

Water Grass (*Echinochloa crus-galli*).—This weed infests low marshy places, frequently becoming a pest in alfalfa fields where the drainage is not good. It is not apt to be serious when the conditions for the alfalfa and the stand of alfalfa are good. In rice this grass has become a very serious pest. Chas. E. Chambliss[1] says:

> "During the past three years this grass has taken complete possession of more than 2,000 acres of rice land in Sacramento valley, and is now present in alarming quantities on a considerable acreage, which will soon be rendered unprofitable for rice growing unless active steps are taken for its complete eradication or control."

The seed germinates at the same time as the rice and the plants grow to maturity in about sixty-five days. If this first crop is allowed to go to seed a second crop will develop before the rice is ready to harvest.

Control.—To prevent the further spread of this grass *sow clean seed*. It would be well if this could be an absolute command to the prospective rice planter. Have seed tested by the county horticultural commissioner or the farm adviser, and if it is not clean seed do not buy it.

When water grass is present, prevent it from going to seed if possible. Individual plants will produce as many as 40,000 seeds.

Plow, harrow and irrigate land in the fall. This will tend to germinate weed seeds and leave the land clean for spring sowing. In bad cases crop rotation will be necessary, using, if possible, some hoe crop. Summer fallowing is also practiced with good results.

[1]U. S. Dept. of Agriculture, Farmers' Bul. 688.

Ditch banks should be kept clean as well as levees in the field. For cleaning the banks a strong solution of sodium arsenite should be used, 4 pounds to 100 gallons of water. It is better to purchase this material already made up, if possible, as it is very poisonous and hard on the eyes and skin.

Screens should be placed in the headgates, using a very fine mesh screen for the inner gates. They should be cleaned very frequently, so as not to obstruct the flow of the water.

The following warning to rice growers has just been issued by the Sacramento Valley Development Association:

WARNING TO RICE GROWERS.*

To Rice Growers and Owners of Rice Lands—

Look out for water grass and other dangerous weed pests.

If your land is free of these, keep them out.

If your land is slightly infested, eradicate at once.

If your land is badly infested, take drastic measures with two purposes in view—first to prevent their spread, second to eradicate or control them

Sow clean seed—this is most important.

Use clean water—screen it if necessary.

Pull the grass out of your fields; it is lighter green than rice. Use a spud and cut below the crown of the plants.

If it is too thick to pull, grow cultivated crops and cultivate well. A later bulletin will tell how to do this.

If your land is foul, don't plant rice this year. You will get a light crop and a low price and your weed problem will be worse next year. Clean your land and clean it now. This will be most economical. Urge your neighbor to clean his at the same time.

Remember rice is a profitable crop—the most profitable that can be grown on much of the rice lands—and that it will continue profitable provided only these weeds are kept under control.

Water grass seed in your rice means a lower price for your crop.

Water grass seed on your land means no rice in the near future.

Don't underestimate the importance of the rice weed problem. The profits of the industry depend upon its being solved, and it *must* be solved right away.

Don't imagine you can kill these weeds by growing barley. You can't. To kill them after they are well set is a big job and will cost money.

Don't be afraid to spend money when they first appear. This is the time to kill them, the time when eradication is easiest and cheapest.

Land owners leasing lands for rice culture should REQUIRE lessees to keep fields, borders and ditches clear of these weeds. Put it in the lease and enforce it. Reserve the right to do it at the expense of lessee—then do it at the right time if he does not.

Ditch companies should keep their ditches absolutely free of these weed pests. County roads must be kept clean.

These things can all be done. They will pay. They *must* be done.

Every farmer should study the above, and follow the advice given.

Morning Glory (*Convolvulus arvensis*).—There are three methods employed against this weed, all of which are effective and of value in their place.

Smothering has been practised on small patches of morning glory, Canada thistle, creeping malva, and others with considerable success. It has been tried especially where the pest had not become scattered.

*Bulletin No. 1, issued by the Rice Committee of the Sacramento Valley Development Association.

and found to be efficient. It must be remembered that a much larger area than that immediately occupied by the plants must be covered, otherwise sprouts will be found springing up beyond the covering. Straw, manure, boards, tar paper, and old sacks have been used. The object is to exclude the light as much as possible.

Morning glory can also be absolutely eradicated by constant cutting. Experiments by the University of California and the State Commissioner of Horticulture have demonstrated this beyond a doubt. Plowing is not the best method of cutting this weed. Use a horizontal blade weed cutter and set the knife to pass about six inches below the surface of the ground. Repeat the cutting every six or ten days, according to the rapidity of growth. Keep all green leaves down. If the green leaves are allowed to appear they begin to manufacture more food for the underground rootstocks, and the work expended is wasted. Irrigate the land where possible, as this stimulates the dormant roots and hastens their final exhaustion.

Under this method if the morning glory is in the field it is possible to grow a crop before the weed cutting begins. Plow in the spring and sow to grain. After harvest plow again and then commence to use the weed cutter.

CHEMICALS.

Experiments with chemical weed killers have demonstrated that morning glory and many other weeds can be controlled. We hope before long to complete experiments which will prove that morning glory and Johnson grass can be completely eradicated by the use of chemical sprays.

Spray with iron sulphate, 100 pounds to 50 gallons of water, or use arsenite of soda, 1 part to 60 parts of water. The time to spray morning glory is in the dry season, when the plants will absorb the spray readily. Experiments tried in 1915 by Geo. P. Gray, of the University of California, showed killing of the roots to the depth of three feet. Arsenite of soda was used in this test. A high pressure sprayer should be used, preferably a power machine.

Wild Mustard (*Brassica arvensis*).—Spraying with iron sulphate is the most practical and economical method of ridding large farms of mustard and other weeds. Experiments have been conducted at several agricultural experiment stations, to determine the practicability of sprays as a means of weed control, and the results have amply justified the work. Thousands of dollars can be saved the large grain grower by eradicating weeds from his fields. Iron sulphate will kill or control mustard, cocklebur, ragweed, dandelion, daisies, wild lettuce, morning glory, thistles, kinghead and many other broad leaved plants, without harming the grain in the least.

The method of preparing the solution and the application are taken from Bulletin 179, University of Wisconsin Agricultural Experiment Station, entitled "Eradication of Weeds with Iron Sulphate."

Empty 100 pounds iron sulphate into a 52 gallon cask and fill with water. Kerosene and vinegar barrels are usually gauged at 52 gallons. If tank of unknown size is used, put in $\frac{1}{5}$ iron sulphate to $\frac{4}{5}$ water by weight. One hundred pounds of iron sulphate is sufficient to make enough solution to treat one acre, and the sprayer should be so regulated

that it will cover an acre with 52 gallons. No harm will be done if the solution is put on heavier but the cost of material will be more.

Spray with a power sprayer, special types of which have been developed for this work. The time to spray is when mustard is about 8 to 10 inches high, that is, when nearly all the seeds have sprouted. Spray on a sunshiny day to get best results.

The ordinary orchard spraying machine can be converted into a field sprayer by connecting a cross pipe, fitted with several spray nozzles, to the outlets. The object of this is to cover a larger area. The spray should issue as a mist, and not in drops as from a sprinkler. The force is used to penetrate the hairy or waxy coating of the weed leaves and reach the vital parts of the plant.

Johnson Grass (*Sorghum halapense*).—Where Johnson grass does not occur, the thing to do is to keep it out. Sow Clean Seed! The method of procuring clean seed has already been given. There is great danger that sowing Sudan grass will spread Johnson grass, and the State Commission of Horticulture has investigated the possibility of procuring pure Sudan grass seed. The most satisfactory information we received came from the United States Department of Agriculture, and is given below:

> "There are no varieties of Sudan grass seed recognized at the present time, though there is some difference in regard to seed. This is mainly due to hybridizing influences. The Texas station has attempted to differentiate between pure and mixed or hybridized seed by indicating the former as 'cream hull,' or that which has a decidedly golden cream color. Seed with darker glumes or that tending to a reddish color, or even black, is more likely to be a mixture or hybrid seed. This can not, however, always be depended upon. The only safe method of procedure is to purchase seed that is grown in districts free from Johnson grass.

The letter supplied the names of growers of Sudan grass seed which could be guaranteed practically free from Johnson grass. We would advise those intending to plant Sudan grass to communicate with Mr. Roland McKee of the Bureau of Plant Industry, U. S. Department of Agriculture, or with this Commission.

The Johnson grass problem in California is already a very serious one. Thousands of dollars have been spent in its attempted control and still it remains one of our worst weed pests. Hundreds of acres have been completely abandoned to it. If the most rigid care is not taken by prospective grain planters and seed men, still greater areas will be ruined. Witness the misfortune of the rice growers and take warning.

The only practical method of eradicating Johnson grass, so far recommended, is thorough plowing, raking and burning. Turn hogs into the field and they will root out large quantities of the rootstocks. Rotate crops, using hoe crops wherever possible.

Keep ditch banks, roadsides and other waste places free of the weed. Do not allow it to go to seed. Screens in the headgates and ditchgates will keep out large quantities of the seed. Johnson grass and other weeds growing along the ditch banks are a serious means of spreading weed seed.

Do not get the idea from what has been said about Johnson grass that it cannot be controlled. Although sometimes it may seem impossible, we know it can be done, because it has been done. It requires time and perserverance, and it costs money. There is no easy road to eradication. There is much land from which it will not pay to eradicate Johnson grass by our present methods. We are now working on chemical sprays as a possible means of reducing the expense and increasing the efficiency of eradication methods. These sprays have not yet been sufficiently tested to be recommended.

I want to include here a statement made by County Horticultural Commissioner William Wood, at the California State Fruit Growers' Convention, held at Visalia in November, 1915:

> "Some may think from the statement I have given about Johnson grass and morning glory that it is a hopeless task to destroy or control them. Not so! Wherever we find a good farmer there is no Johnson grass, even though he is located under the most adverse conditions. It is the farmer who has made one or two half-hearted attempts to destroy these weeds and given it up, who says it can't be done.
>
> "I have known men who have let the Johnson grass and morning glory became established over most of their farm, and then have sold their property for less than half what it would have brought if free from these weeds. I have also known a man who bought 100 acres covered with Johnson grass. This man destroyed every root on the 100 acres in one year. So you will see the difference is in the man more than the unfavorable conditions under which he has to work * * *."

This statement is quite true. I have heard it from all sides, and always from good hard-headed successful business men. The weed problem is a vital one, and it is one we must constantly watch. We must have laws to help us protect those who are endangered by the carelessness of others. We must have a seed law which will be leak proof. We have a horticultural law which can be enforced and we must see that it is enforced to the fullest extent possible.

EELWORM PARASITES OF PLANTS.*

By PETER FRANDSEN, Professor of Biology, University of Nevada.

Earth, rich in decaying organic matter, sometimes swarms with microscopic cylindrical worms, which, because of their wriggling movements, are known as eelworms. The most of these feed upon decaying substances and are probably beneficial in hastening the disintegration of animal and vegetable matter so that it may again be available for plant food. Certain forms have, however, acquired the habit of entering the tissues of living plants, where they live as parasites, causing more or less injury to their hosts. The parasitic species are distinguished from the nonparasitic by the possession of a minute spear which can be protruded from the mouth opening and enables the animal to make its way into the roots and through the tissues of the plant.

Among the parasitic forms the one known as *Heterodera radicicola* is becoming of increasing importance in this western country, because of its wide distribution and the number of different kinds of cultivated plants that it attacks. We now have records of some 500 species of plants which are attacked, and these include the majority of truck garden crops, alfalfa, clovers, some grains, a number of fruit trees and a host of weeds. The presence of the parasite is indicated by the formation of swellings on the roots and underground stems, which somewhat resemble the root bacteria nodules but are more irregular in shape and size, and stand out less sharply from the rest of the root. A heavily infested potato presents a characteristic appearance, one hard to describe but readily recognized with experience. Its surface is marked by numerous pimples, small warts, creases and ridges. On cutting across the tuber one can see the mature females somewhat pear-shaped or circular in cross section, about 1-25 inch in diameter, of a grayish white color, and marked off from the tissues of the potato by a brownish ring. The appearance of a heavily infested potato is not attractive to the housekeeper and diminishes its selling value. There is considerable loss of substance in paring, as the worms may penetrate to a depth of a quarter of an inch, and the keeping qualities appear to be lessened.

Each mature female is little more than a sac containing from 300 to 500 eggs, which may undergo development inside her body. As the eggs enlarge some of them are extruded. In from 20 to 28 days the eggs hatch and the minute larvæ, 1-70 inch long, emerge and, aided by the decay of the tuber or roots in the soil, eventually make their way into the ground and move about until they find a suitable root which is entered, as a rule, from the tip. We have found that they also enter the young potato tubers by way of the lenticels or breathing pores. Several worms usually enter the same spot. After repeated moultings the larvæ transform into mature males and females. The former are elongated and cylindrical in shape while the latter become pear-shaped. Mating occurs within the plant substance and the male then dies. It requires about a month for the larvæ to mature and the whole life history occupies from seven to eight weeks.

*Address before State Fruit Growers' Convention, Palo Alto, California, July 30, 1915.

The worms are distributed from one section to another by infected seed potatoes, transplanted seedlings, nursery stock and the like. Irrigation is one of the most important methods of carrying the worm from one field to another, and one of the most difficult to control. Farming implements may transfer worms by means of the adhering soil, but our experiments show that if the soil is thoroughly dried out all the worms are killed so there is probably very little danger from the drifting of soil by the wind. Some experiments were carried on to test the possibility of spreading the parasite by means of the manure of animals fed upon infested plants, and it was found that all eggs and larvæ were destroyed in the stomach by the gastric juice.

The eggs and larvæ are quite resistant to frost, but freezing temperatures for a sufficient length of time will kill them. The long cold winters of the northern and eastern states are probably the chief cause for the absence of any eelworm problem outside of the greenhouses. The character and consistency of the soil plays some part in the degree of resistance to frost. We are now at work to determine the depth to which the worms may penetrate different soils.

It has been suggested that fields might be rid of the worms by flooding them with water but our experiments indicate that at least three months submersion would be necessary to make this method effective.

On the other hand we have found a surprising lack of resistance to drying. Eggs and larvæ placed on a glass slide and allowed to dry out for a few minutes fail to show any signs of further development, and if infected roots and tubers are allowed to thoroughly dry out all the contained eggs and larvæ are killed.

There is also very little resistance to heat. Some eggs and larvæ were placed in an incubator at a temperature of 40° C. with the idea of hastening their development. While development was greatly accelerated in the first few hours, to the extent that some of the eggs began hatching before the embryos had reached the proper stage of development, at the end of 18 hours every egg and larvæ was dead. Infested potato tubers were likewise placed in the incubator at various temperatures for different periods of time, and it was found that 23 hours was sufficient to destroy the parasites without apparently interfering with the germinating power of the potato. A longer period of exposure than this impaired or destroyed the germinating power. Since it is difficult to be sure of one's seed if it comes from an eelworm locality, because a slight infestation may easily escape even careful inspection, it is possible that such seed may be made innocuous by placing it in an oven for 24 hours at a temperature of 40° C. before planting. We are now testing this out.

A question frequently asked by the farmer is, "Can't we treat the seed and soil with some chemical substance which will rid them of the worms?" Previous investigators have found that liberal treatment of the soil with alkaline fertilizers seems to be unfavorable to the worms but cannot be counted upon to exterminate them. One Nevada rancher claimed that he had a method of applying bluestone which kept the eelworms from bothering him. We treated worms and infested plants with various strengths of copper sulphate solution and found that even a one per cent solution, which is distinctly poisonous to vegetation, acting for two days directly on the worm, failed to destroy a single egg.

The formalin treatment for scab had no appreciable effect on the vitality of the worms in the tubers. We are now carrying on experiments with other substances, but so far have found nothing which appears feasible as an exterminator.

The practical farmer is not so much interested in the scientific details of our studies on the effects of the parasite on its host, or the peculiarities of its life history and habits, as he is in remedial measures. In the light of our present knowledge these, with special reference to the potato, may be summarized as follows:

1. Selection of potato seed from localities known to be free from the parasite.
2. Planting potato crops in noninfested ground.
3. Summer fallowing of infested ground, keeping it free from weeds. It is not yet known exactly how long the worms can live in soil kept free from food plants but the indications are that one season will starve them out.
4. Deep plowing, preceding a period of hot dry weather, so that the soil is well exposed to the heat of the sun and becomes thoroughly dried out.
5. Rotation of crops. The following plants are recommended by men in the United States Department of Agriculture for use in crop rotation as immune, or only slightly susceptible to the eelworms: barley, beggarweed, Brabham cowpea, broomcorn millet, corn, crabgrass, iron cowpea, peanut, pearl millet, redtop, rye, sorghum, timothy, velvet bean, wheat, winter oats. We have succeeded in getting a marked infestation of corn and oats but even if these crops are not wholly immune they may serve the purpose of greatly reducing the number of worms.

FIG. 27.—Potatoes showing the work of the common nematode or potato eelworm. The section shows the colonies of the eelworms in the tuber. (After Essig, Inj. and Ben. Insects of Cal., Cal. Hort. Com.)

THE MONTHLY BULLETIN

CALIFORNIA STATE COMMISSION OF HORTICULTURE.

DEVOTED TO HORTICULTURE IN ITS BROADEST SENSE, WITH SPECIAL REFERENCE TO PLANT DISEASES, INSECT PESTS, AND THEIR CONTROL.

Sent free to all citizens of the State of California. Offered in exchange for bulletins of the Federal Government and experiment stations, entomological and mycological journals, agricultural and horticultural papers, botanical and other publications of a similar nature.

A. J. COOK, State Commissioner of Horticulture____________________________Censor
E. J. VOSLER, Secretary State Commission of Horticulture___________________Editor

ASSOCIATE EDITORS.

GEO. P. WELDON____________________________________Chief Deputy Commissioner
HARRY S. SMITH__________________________________Superintendent State Insectary
FREDERICK MASKEW______________________________Chief Deputy Quarantine Officer

Entered as second class matter December 29, 1911, at the post office at Sacramento, California, under the act of July 16, 1894.

A Suggestion—Think It Over and Talk About It.—During the Fruit Growers' Convention held at Visalia in November, 1915, a movement was inaugurated and the machinery provided for a general reorganization of the Horticultural Statutes of the State of California. In consonance with the principles of this movement we offer the following rough draft of a suggested change in the methods at present employed in executing the provisions of the State Quarantine Law at terminal points throughout the State, hoping that the same will elicit criticisms and further suggestions which may tend to ultimately perfect and make the plan workable.

Under the present system our functions are confined to putting into execution the provisions of this law at the maritime ports of entry, and as a result of pursuing a definite, fixed policy of administration and a uniform system of operations we are generally credited with having obtained a fair measure of success in the undertaking. These results we believe could be duplicated in connection with all horticultural imports arriving by rail if interior ports of entry or clearing houses for such material were established. The geography of the situation lends itself favorably to the consummation of this plan. The present routes of the six interstate railroads entering California are such that but two ports of entry would be needed to meet these requirements. Practically the first distributing point for the Shasta Route, the Ogden Route and the Western Pacific after entering the State is at Sacramento. The same applies to the Southern Pacific, the Santa Fe and the Salt Lake at San Bernardino. With a regulation that all imports of plant products coming by rail were to be held at these points, with inspection stations established at these same places, operated by state inspectors under the same policy and procedure as obtains at the maritime ports, many vexatious problems would be permanently solved and the entire system of inspection and control of horticultural imports simplified.

made uniform and perhaps improved. With a full knowledge of the statistics involved the expense of maintaining such a system would be negligible as compared with the one at present in vogue. The method of control as outlined would not conflict in any way with material coming in bond. Such could be routed through to destination as inspection stations are already established and in full operation at all points where customs duties are paid and collected, and further, it is possible that once such inspection stations were established and in good working order, the Federal Government might see its way clear to establish a depot in each one for the inspection and disposition under post-office regulations of all plant products coming in by mail.—FREDERICK MASKEW.

Concerning the Mediterranean Fruit Fly.—Considering the following record worthy the attention of the fruit growers of California and with a desire to make the same readily available for reference purposes, this transcript from the original Italian, published in the Review of Applied Entomology, Vol. 3, Series A, Part 12, is herewith reproduced.

Savastano (L.). *La mosca delle arance e la frutticoltura meridionale.* (The Mediterranean Fruit fly and fruitgrowing in South Italy.)—R. Staz. Speriment. Agrumic. Fruttic., Acireale, Boll. no. 14, October, 1914, 8 pp. (Received 26th October, 1915.)

This bulletin deals briefly with the influence of *Ceratitis capitata* Wied., (Mediterranean Fruit fly) on fruit growing in South Italy. In November, 1913, oranges and mandarins began to be attacked; the infestation increased in December, 1913, and diminished in January, 1914. From February to May, larvæ were found in the oranges and mandarins both stored and on the trees. In June, the adult flies which emerged from oranges attacked others, as well as peaches and the flower clusters of figs; the injury to them increased in July, while apricots, figs and prickly pears were then also attacked. Damage to the last three fruits continued during August, in which month Neapolitan medlars began to be attacked. In September, the attack on peaches, figs, prickly pears and Neapolitan medlars continued, but with rapidly diminishing intensity. In October, injury to figs had practically ceased. This makes clear the means by which *C. capitata* is able to maintain its existence throughout the year.

Reviewing the practically continuous period of ripening of fruits in California, any comment or attempt at local application of the foregoing scientific findings and record would be superfluous.—F. M.

A Tribute.—The following tribute by Mr. Frederick Maskew, Chief Deputy Quarantine Officer, San Francisco, was written for the "United States Customs and Kindred Services." We feel certain that all who know of Mr. Compere's unswerving integrity, sterling honesty and untiring fidelity in the service of the State appreciate his great work in safeguarding the fruit interests against the ravages of fungous and insect pests.—A. J. C.

GEORGE COMPERE.

He know's 'em by their looks,
But he didn't learn from books
Or from reading of their histories in tomes;
Be it bug or caterpillar,
Coccid, fly or little miller,
He has made them all a visit at their homes.

With passengers and ships,
In stream or at the slips,
He's a way of doing business that commends,
With officers and crew,
And many others too,
And his common sense has made a host of friends.

A lover of plant life,
No passenger meets strife
Should they bring with them from foreign lands a tree;
If of bugs its leaves are clean
And no fungi can be seen
And if Compere finds its roots from soil are free.

But when it comes to fruit,
Trade shipments or just loot,
He's a knowledge of locations that's uncanny;
Hand bag or box or trunk,
Gallery, locker, hold or bunk,
For of voyages himself has made a many.

Herein the danger lies,
Of bringing in fruit flies,
And from this search he never takes a rest;
From all of those who know,
He can the best proofs show,
Of most intimate acquaintance with this pest.

Here's to his methods straight,
May never ships or freight
Fail to undergo his thorough supervision;
Here's to his honest self,
His disregard of pelf,
He's a credit to the Quarantine Division.

NOTE.—Frederick Maskew in "United States Customs and Kindred Services" San Francisco, December, 1915.

COUNTY HORTICULTURAL COMMISSIONERS' DEPARTMENT.

THE MEALY BUG OF THE MUSCAT GRAPE.

By Fred K. Howard, Horticultural Commissioner, Hanford, Cal.

Although the mealy bug, probably *Pseudococcus bakeri* Essig, has been known to infest table and wine grapes, in some of the grape growing sections of the San Joaquin Valley, to a limited extent for several years, it was not until 1914 that the infestation became economically important in those districts. To my knowledge this insect had never been found on raisin grapes until taken by the writer in an old muscat vineyard north of Armona, Kings County, about the middle of September, 1915, although, no doubt, the pest existed in parts of the raisin growing district of this county for some years prior to that date.

Fig. 28.—Grapes infested with mealy bugs. (Original.)

The casual observer will probably first become aware of the presence of the insect by the globules of crystal clear honeydew which it exudes in large quantities upon the clusters of fruit. Closer observation will reveal the insect, which is easily distinguished by the white, waxy covering, and the anal filaments which are usually about one half as long as the body of the insect, although in some individuals they are much longer and might easily be taken for the long tailed mealy bug *P. longispinus* (Targ.). They may usually be found on the berry at or near the stem end, although are often found, especially in cases of severe infestation, on the leaves and tender canes, the usual place being at the base of the leaf stalk.

The egg laying season is at its height when the grapes are ready to be picked and placed on trays for drying. The loose cottony masses which contain numerous small light yellow eggs, are easily seen as they adhere to the grape cluster, and combined with the sticky exudation of the insect make a very disgusting spectacle. After the fruit is placed on the drying trays, it soon becomes too warm on the surface for the insects, and they make their way to cooler quarters, beneath the fruit next to the tray, and are little noticed until the trays are turned to complete the drying.

Apparently the humid conditions found by the insect in the spaces between the fruit and the tray, are ideal. It is here that one of the most detrimental features of its work is accomplished. The work is so concentrated, and honey dew is exuded in such large amounts, that under those conditions it quickly attracts a smut fungus, which I believe was the cause of a greater part of the rotting on the trays during the past season, in this section. To this damage may be added the appearance of the white, cottony egg sacks, and the dust and dirt of all kinds which readily adheres to the sticky clusters, as well as a great amount of shattering, caused no doubt, by the insect working at the stem end of the berries. In the worst infestations much of the fruit is ruined entirely, and a greater portion is rendered unfit for cluster or fancy packs. At the present time no observations have been made to determine how serious the weakening effect will be on the vine, as the damage to ripening and drying fruit is at this time of major importance.

Experiments were started hoping to determine, if possible, if young insects would survive, or eggs hatch, after the raisins were packed, and if so, to determine the amount of possible damage. Owing to the rush at the packing houses in handling the enormous crop which was produced this season, the experiments were necessarily abandoned until next year.

At this writing no satisfactory control measures have been worked out. It is evident that this work should be done during the dormant season, because at this time the insect is not half grown, and is not protected by the waxy covering in such large quantities as in the adult stage, when a spray of sufficient killing strength would no doubt greatly injure the vine. However, many difficulties must be overcome to secure satisfactory results even when the vine is dormant, as the insect spends the winter feeding on the tender bark, in cracks and crevices, often so protected by layers of old, rough bark that to reach them with a spray seems impossible. It will, no doubt, be necessary to use a very penetrating contact spray, under heavy pressure and applied very thoroughly, to kill a satisfactory percentage of the insects.

Exhaustive experiments with various spray materials and fumigants are being planned for the coming season, and satisfactory results are anticipated.

THE WHEAT STRAW WORM.

(*Isosoma grande* Riley.)

By R. W. DOANE, Stanford University.

California grain fields are not yielding as much wheat per acre as they used to yield. The principal reason for this is usually, and probably rightly, ascribed to the fact that the soil is becoming depleted by being used for the same crop year after year, often without being plowed deeply enough to break up the hard stratum that forms just below the soil that is reached by the plow when the field is plowed in the usual way.

Studies made during the past two years, particularly in the wheat fields in northern California, have shown that another very important factor, and one that has been quite overlooked here, is contributing its

FIG. 29.—Young wheat showing the effects of the work of the larvæ of *Isosoma grande*. In the middle stalk is an adult just ready to issue. (Original.)

part toward decreasing the wheat yield. It has long been known that the wheat straw worm, *Isosoma grande*, occurs in California, but few, if any, have realized its importance here. The insect works in such a way that, even when very abundant and destructive, its presence may readily be overlooked and the damage that it does may be ascribed to other causes. In some fields actual count of hundreds of wheat stems

showed that more than 84 per cent were infested with one or more larvæ or pupæ of this insect; and it was not known that the insect occurred in that part of the state.

LIFE HISTORY OF THE INSECT.

The life history of this insect in California is, briefly, as follows: During the summer and fall the small whitish larvæ may be found in the wheat stems, usually close to or actually in one of the joints. Any part of the stem may be infested but the larvæ are most commonly found near the third joint. As early as September some of these larvæ change to the pupal stage but many remain in the larval stage until January or February. In January, however, most of the insects will be found to be in the pupal stage.

About February 1st the first generation of adults begins to appear. These are small, black, wingless insects, looking so much like ants that the ordinary observer would readily believe them to be ants. They soon deposit eggs in the young plants of winter wheat, placing them, with remarkable accuracy, close to the young wheat head which at this time is just beginning to develop in the heart of the plant. The larvæ that hatch from these eggs work within the short stem of the plant and in a short time destroy the most vital parts, including the embryonic head. The larvæ soon become full grown, pass quickly through the pupal stage and very early in the spring—late in February or early in March—the adults of the second generation begin to appear.

The adults of the second generation are winged and scatter over the field or into near-by fields. The females often select the largest, most vigorous plants in which to lay the eggs that are to produce the larvæ which will live through the summer, and change to the over-wintering pupæ in the fall or early winter.

CHARACTER AND EXTENT OF THE INJURY.

The larvæ of the first generation usually do the most damage, as they attack the wheat when it is very small, often killing the whole plant. If the plant is not killed, the earliest, strongest central stalk is destroyed and the plant stools excessively. The crop that develops must come from these stools, which develop weaker and later stems than are found on the uninjured plants. If the stand is already poor the loss of many plants due to the attacks of this insect may be serious; or the loss of time due to the fact that the stalks which develop from the stools mature later than the others, may be important, especially in a dry season.

If the adults of the second generation lay their eggs in very young wheat, the effect of the work of the larvæ will be much the same as that described for the larvæ of the first generation. The small plants will seem to grow well for a while, the lower leaves being especially strong and vigorous, but the stem remains short and the whole plant may die or stool excessively. If the wheat is older, the effect of the presence of the larvæ in the stems is not apt to be as serious—at least it is not as apparent. The infested plants may form heads which may or may not become well-developed. Usually the presence of a larva in a stem causes more or less thickening of the walls of the stem and the upper part of the plant is not well nourished. The heads that form on such plants are usually small, or the kernels do not fill out well and a light crop, or a crop of small, shrunken grain, is the result.

The following generalizations in regard to the injury done by the larvæ of the second generation may be made:

Infestation of very young plants may kill them or cause them to stool excessively.

Infested stems are usually, but not always, shorter and have smaller heads than stems that are not infested.

Early infestation, particularly in the lower joints, affects the height and size of the stem and the size of the head, usually making the head small or very small.

FIG. 30.—Wheat straws that have been badly injured by the larvæ of *Isosoma grande.* (Original.)

An early infestation of the highest or next to highest joint affects the size of the head but does not appreciably affect the height of the stem.

Infestation of the third joint does not seem to affect the plant as seriously as infestations higher or lower, made at approximately the same time.

A very late infestation may occur in one, or even in two or three joints, without seriously affecting the stem or the head.

CONTROL.

As the insect passes so much of its life in the straw or stubble that is usually left on the field, and as the adults of the first generation are wingless, simple effective remedies are at once suggested. If all of the straw and stubble can be burned, the over-wintering larvæ and pupæ will be quickly destroyed, or if the fields are carefully plowed so that all of the stubble is deeply buried, few of the insects will survive. It

will be seen, too, that, as the adults of the first generation are wingless, a rotation of crops would be effective, for if wheat is planted in a field that was in some other crop the year before, there will be no source of infection except the light infestation that may come from nearby fields when the second generation of adults appears.

THE SOFT BAMBOO SCALE.

(*Asterolecanium bambusæ* Boisduval).

By E. O. Essig, University of California, Berkeley, Cal.

This coccid has been repeatedly taken at quarantine by state horticultural officials for many years, but was not known to have become established in California and the United States until March 1, 1914,

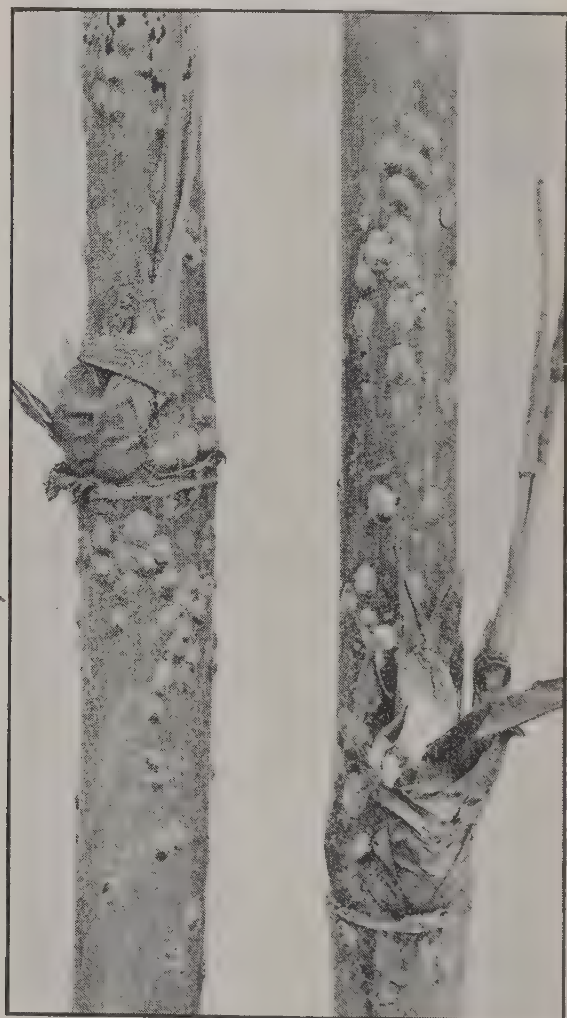

Fig. 31.—The soft bamboo scale, *Asterolecanium bambusæ* Bdv. on bamboo stalks. Enlarged twice. (Original.)

when it was taken on growing bamboo in a private garden at Ventura by S. H. Essig, horticultural inspector. It was again reported from Sierra Madre by E. J. Branigan[1] in 1915.

[1] Mthly. Bul., Cal. Hort. Com., Vol. IV, p. 484, 1915.

The insect has a soft, unprotected body which is regularly oval, decidedly flattened and with the surface slightly convex. The color varies from pale yellow to amber or grayish-black. The surface is smooth and shiny. The length of the mature forms averages about 2 mm. and the width about 1.5 mm. The accompanying photograph (Fig. 31) will aid in distinguishing it. Only one other representative of the same genus occurs in California, the pit-making oak scale (*Asterolecanium variolosum* Ratzeburg), which is also an introduced species occurring at Stockton and Palo Alto.[2]

The soft bamboo scale has quite a wide foreign distribution, having been reported from the following localities[3]: Algeria, Grenada, Mauritius, Ceylon, Brazil, West Indies and Mexico.

As it does not produce any considerable amount of honeydew, causes little smutting and does not seem to injure the hosts to any marked degree, it may be considered of very minor importance as an economic insect.

[2]Inj. and Ben. Ins. Cal. 2d edit., Cal. Hort. Com., p. 113, 1915.
[3]Fernald, Mrs. M. E., Catalogue Coccidæ, p. 49, 1903.

QUARANTINE DIVISION.

Report for the Month of December, 1915.

By Frederick Maskew.

With this report ends the record of perhaps the busiest year of the State Horticultural Quarantine Service since the date of its inception. From all stations of the Division came reports of an increased volume of imports and of diligent endeavors to maintain a proper supervision over the health and cleanliness of the same. Official investigation of the methods and policies in force at the southern stations shows system and economy in the work, supplemented by adequate office facilities and a general desire to maintain the traditions of the service. State Quarantine Guardians at interior points of delivery functioned with sagacity, and as a rule were prompt with reports of their findings and dispositions of imported plant products. At the central quarantine office in San Francisco every day of 1915 was replete with action. Horticultural imports increased, passenger traffic multiplied, quarantine regulations were augmented, conferences became common, yet the numerical strength of the inspection and clerical force remained the same. The many episodes attendant upon our share of the work connected with exhibits of plant products at the Exposition were varied and novel. At times the situation was difficult but never impossible. Our course under the statute was clear; we held the fort; each unit of the service rose to the occasion and our records show that we executed all the provisions of the quarantine regulations with impartiality to the importers, with safety to the State and perhaps a small measure of credit to the service. For all of which we were paid in full and the account stands balanced up to date.

SAN FRANCISCO STATION.

Steamship and baggage inspection—

Ships inspected	79
Passengers arriving from fruit fly ports	3,835

Horticultural imports—

	Parcels
Passed as free from pests	153,148
Fumigated	4,817
Refused admittance	245
Contraband destroyed	22
Total parcels horticultural imports for the month	158,232

Pests Intercepted.

From Acapulco—

Lepidosaphes gloverii on limes.

From Balboa—

Pseudococcus sp. on crotons.
Coccid on palm.

From Belgium—
Aleyrodes sp. on azaleas.

From Brazil—
Cerataphis lataniæ on orchids.

From China—
Lepidopterous larvæ in garlic.
Melanose on pomelos.

From Greece—Patras—
Saissetia oleæ and *Parlatoria calianthina* on olives.

From Hawaii—
Chrysomphalus aurantii on orchids.
Trypetid larvæ in red peppers.
Pseudococcus bromeliæ and *Diaspis bromeliæ* on pineapples.
Coccus longulus on betel leaves.
Hemichionaspis sp. on air plant.
Lecanium sp., *Pseudaonidia* sp., and *Aspidiotus* sp. on unknown plants.

From Holland—
Lepidosaphes ulmi on boxwood.

From Japan—
Larvæ of Weevil in chestnuts.
Parlatoria sp. and *Hemichionaspis aspidistræ* on maples.
Fungus on tangerine oranges and lemons.
Calandra sp. in wheat.
Aleyrodes sp. on gardenias.

From Philippine Islands—
Pseudococcus sp. on pot plants.

From Samoa—
Morganella maskelli on oranges.

From Sydney—
Chrysomphalus aurantii on Kentia palm.

From Tahiti—
Morganella maskelli on limes.

From Washington—
Crown gall on apple tree.

LOS ANGELES STATION.

Ships inspected	46
Horticultural imports—	Parcels
Passed as free from pests	117,484½
Fumigated	54
Refused admittance	110
Contraband destroyed	30½
Total parcels horticultural imports for the month	117,679

Pests Intercepted.

From Belgium—
Aspidiotus brittanicus and *Coccus hesperidum* on bays.

From Central America—
Aspidiotus cydoniæ and *Chrysomphalus scutiformis* on bananas.

From Florida—
Phomopsis citri on grapefruit.

From Holland—
Lepidosaphes ulmi on boxwoods.

From Idaho—
Rhizoctonia on potatoes.

From Japan—

Chionaspis citri, *Aspidiotus* sp., *Chrysomphalus aurantii*, *Pseudococcus nipæ*, *Parlatoria* sp., *Lepidosaphes gloverii*, *Pseudaonidia trilobitiformis*, *Cladosporium citri* and *Leptothyrium pomi* on oranges.

From Nevada—

Heterodera radicicola on potatoes.

From Oregon—

Coccus hesperidum on holly.
Aspidiotus perniciosus on rose.

From Texas—

Aleyrodes sp. on Cape Jessamine.

SAN DIEGO STATION.

Steamship and baggage inspection—

Ships inspected	25
Fish boats inspected	48
Passengers arriving from fruit fly ports	59

Horticultural imports—

	Parcels
Passed as free from pests	19,218½
Fumigated	1
Refused admittance	3½
Contraband destroyed	1
Total parcels horticultural imports for the month	19,224

Pests Intercepted.

From Nebraska and Iowa—

Crown gall on deciduous stock.

From Louisiana—

Chrysomphalus sp. on grapefruit.

From Mexico—

Lepidosaphes beckii on lemons.

From Texas—

Root knot on deciduous stock.

EUREKA STATION.

Steamship and baggage inspection—

Ships inspected	0

Horticultural imports—

	Plants
Passed as free from pests	28,650

SANTA BARBARA STATION.

No horticultural imports.

THE MONTHLY BULLETIN

CALIFORNIA STATE COMMISSION OF HORTICULTURE.

Vol. V. March, 1916. No. 3.

WALNUT CULTURE IN THE LOWER SAN JOAQUIN VALLEY.*

By W. W. FITZGERALD, Stockton, Cal.

There are imported into the United States from Europe annually about 16,000 tons of walnuts, principally from France. California produces more walnuts than any other country except France, and when the recent plantings in the different parts of the State come into bearing it will take first place. At present most of the nuts are grown in Southern California and mostly from seedling trees. The California Walnut Growers' Association this year made a price of 13.6 cents for No. 1 soft-shelled nuts, and 17 cents for budded walnuts. Budded nuts mean those from a budded or grafted tree, supposed to be typical varieties.

Last week the California Walnut Growers' Association advanced No. 1 soft-shell nuts to 14 cents a pound and budded nuts to 17½ cents. As there are practically no walnuts left outside of what the Association has, and not many of these, the return to the growers, as estimated by Mr. C. Thorpe, manager of the California Walnut Growers' Association, will amount to nearly $4,000,000. This is mostly from seedling trees. We must not overlook the fact, however, that if France is careful in grading her nuts, she can put a good many tons in competition with our best nuts. The time is rapidly coming when quality is what will be demanded in the walnut.

Today no one thinks of planting seedling trees, as seedling walnuts do not come true any more than does the peach, plum, apple or any other fruit. It is true that we get new varieties from these seedlings, but commercially we are growing them for profit and not for experiment. For this reason the San Joaquin Valley is being planted to budded and grafted trees and the walnuts will all be of typical varieties, will command the highest prices and, with the acreage that is being planted, it is safe to say that it will not be many years before this part of the State will be the district which is noted for walnuts, because they will all be typical varieties.

SOILS FOR THE WALNUT.

The walnut does best in a deep, fairly rich, heavy soil with good moisture conditions, but well drained. It is not fastidious, but responds quickly to proper conditions, so one should not consider the cheapness of land for growing walnuts, but how good it can be obtained for that purpose. Walnuts should not be planted on shallow soil underlaid with hard pan, unless the hard pan is not thick and is underlaid with good

*Address before the State Fruit Growers' Convention, Visalia, California, 1915.

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soil, then the hard-pan may be broken up by blasting and walnuts grown successfully.

Although the walnut is deep rooted and is considerably resistant to drought when grown on proper roots, plenty of soil moisture is necessary. One should not wait until the tree shows lack of moisture before irrigating. The time of irrigation depends somewhat on the rainy season, but those who have the best results and the largest crops of well-filled nuts are those who begin irrigation early—say in May—and irrigate three or four times, three or four weeks apart, giving a thorough cultivation after each irrigation and not allowing the trees to check up in their growth. Of course different soils will require more or less deviation from this rule. Walnuts are sometimes grown without irrigation, but unless planted upon soil on which it is easy to retain moisture by cultivation,

FIG. 32.—Comparison in the nursery of of first summer's growth of first generation hybrid with trees that are not hybrids, but all grown from nuts of the same tree. The sheet used as a background is 7 feet high, showing the height of the hybrid trees.

These hybrids were procured by hand pollenizing. The smaller trees are from nuts that were not pollenized. About 60 per cent of these are hybrids.

more or less irrigation is always beneficial and profitable. Where the trees do fairly well without irrigation, they grow much more rapidly, come into bearing earlier and give much larger crops with water.

On the other hand, if you do not have good drainage or there is a great amount of moisture constantly standing near the surface, the trees will not do well. It is hazardous to grow walnuts on land where the

water level is less than eight feet and where it is liable to rise and stand for a month or two after the trees are planted. Alkali land also is not suitable for walnuts. Here the selection of roots makes a great difference with the moisture conditions. The English root is very fastidious and will not stand too much moisture. The California Black will stand more while the Eastern and the Royal Hybrid—which is a cross between the California Black and the Eastern Black—will stand a great amount of excessive moisture.

ROOT STOCK.

The selection of stock is just as important as varieties, soil, or any other consideration. The stock we use for grafting purposes is the Northern California Black, the Southern California Black, the Eastern or American Black, the Royal Hybrid root, and the Paradox Hybrid,

FIG. 33.—First year's growth of Eureka grafted on first generation hybrid root, showing where tree was cut off about 12 inches above the ground when transplanted and new shoot that is to make the butt of the future tree. (Original.)

which is a cross between the English walnut and the California Black. The Southern Black makes a good root for the south, but my experience with it in the northern part of the State, especially on heavy, moist soil, is that it does not do well, the roots being very susceptible to moisture. The Eastern or American Black is a good root, but it is too slow a grower, taking many years to mature. The Northern California Black makes a very fair root and it is on this root that most of the walnuts are

grafted. When I speak of the Royal Hybrid root I mean a first generation cross between the Eastern Black and the California Black, not a cross of a Royal Hybrid and a California Black. These nuts are best procured by hand pollenizing. Occasionally an accidental hybrid occurs, the pollen being carried perhaps by bees, or a great distance by the wind, but this is rare, as different varieties pollenize at different times. This is Nature's method of keeping varieties distinct, otherwise we would have a conglomeration of all forms of hybrids.

FIG. 34.—Same tree as shown in Fig. 33, showing the method of staking and tying up the tree during the first year's growth and also the shake nailed on the south side of the stake to shade butt of the tree during the hot summer. (Original.)

One could graft part of a tree of one type with that of another type by choosing individual trees that blossom at somewhere near the same time; but types have to be selected for cross pollenizing that will produce vigorous trees for, as with cattle and other animals, certain trees do not reproduce well.

To obtain these hybrids in any quanitity I use trees that have been proven to produce vigorous young trees, by crossing with certain other trees and by gathering the catkins of the California Black just as the pods are ready to burst and expel the pollen. I place them on large sheets of paper in the sun in some protected place where the wind will not blow the pollen away. Care must be taken that this pollen does not become damp, or the catkins allowed to lie on the paper too long, as the

moisture from them will destroy the pollen. Then, after separating the pollen from the refuse of the catkins and stems, I dry it thoroughly and place it in dry pasteboard boxes and keep it in a dark, dry place until the pistillate blossoms of the Eastern Black, which I have selected, come out three or four weeks later, and are ready to receive the pollen—having previously removed the catkins from the Eastern Blacks. Then I place a quantity of pollen in several folded thicknesses of gauze, tie this to the end of a long bamboo fishing pole and by this means I can dust the pollen over the surface of the Eastern Black walnut trees, so as to pollenize the pistillate blossoms. If I watch carefully and pollenize at the proper time, I will have most of the nuts pollenized without the trouble of removing the catkins from the Eastern Black, but, of course, I will not get them all. Then after these nuts mature in the fall, I gather them, sprout them in the spring, and plant them in the nursery. These are first generation hybrids. Now, if I allowed one of these nuts to grow and produce a tree, the nuts which that tree produced would be a second generation hybrid. Again the nut from that tree, if allowed to grow and produce a nut, would be a third generation and so on. Of course, a few nuts may be pollenized from the catkins on the same tree or from trees in the neighborhood, and these will have to be rejected when they come up in the nursery row in the spring. Indeed, I have attempted to pollenize a tree and failed to have one hybrid—due to my not doing the work at the proper time. After they grow a short time in the nursery, it is easy to tell by the character of the leaves and the rapidity of their growth which are hybrids and which are not. The first generation of the Paradox hybrid may be procured in the same way, by using pollen from the English walnut trees on California Blacks. I have often heard people say that a hybrid tree was not as good as, or no better, than the straight California Black; this is due to their using a second, third or more generation nut. The most skeptical are convinced when they see the first generation hybrids grow in the nursery along side of straight California Blacks or second or third generation trees. These hybrids grow at least one-third faster, produce a tree earlier and give larger crops, due to the increased size and vigor of the tree. The Royal hybrid root is the best all around root. It does well in heavy soil and stands lots of moisture. The Paradox hybrid root is just as vigorous a grower, but having the English walnut strain in it, will not stand as much moisture as the Royal hybrid root. It is a better root for light and dry soils.

Another thing which affects the Paradox hybrid root is the oak root fungus, which originated in the roots of oak trees and affects most deciduous fruit trees. I have known it to kill walnut trees on English walnut roots. I know of no case in which it has affected the Paradox root. I have had Paradox hybrid roots planted in spots where the English was killed for the past three years and they have not been affected as yet. If I should plant a walnut grove on land that had previously been covered with oak trees, I would hesitate about planting the Paradox hybrid, as it is too serious a matter to take a chance of having them killed in ten or twelve years when the Royal hybrid root can be planted and there will be no trouble.

It is just as important to select your buds as it is to choose the proper roots. The buds should be selected not only from the most thrifty and

heavy bearing trees, but from individual limbs on those trees that are good producers. While a majority of limbs will produce true there are limbs that will produce irregular and inferior nuts, and also vary as to the amount and the time they will come into bearing. I know of groves that bore fair crops the fourth year after planting, and other groves planted eight years that produced scarcely a nut. It is unfortunate for the industry that many people in planting walnut groves think of how cheap they can get the land and the trees. The first cost of choice land and the best trees is one of the most profitable investments you can make, as the income per acre under these conditions is two to four times as

FIG. 35.—Eureka on first generation hybrid root cut back when transplanted. Through neglect all shoots were allowed to grow instead of choosing one shoot to make the butt of the future tree and having all of the growth thrown into it. (Original.)

great as under improper conditions, while the cost of planting and the care, the taxes and interest on the investment would be the same yearly, in each case.

VARIETIES.

The first thing to be considered in judging the different varieties of walnuts is their producing qualities. I do not mean by this a large producer of an inferior nut, but a heavy bearer of a good quality nut. A tree that produces only a few very fancy nuts is not to be considered commercially. A fancy variety may bring a few cents a pound more, and make up what it would lack in the number of pounds produced,

providing it was not too shy a bearer. The relation between the quality of nuts and the quantity produced should be carefully considered in choosing a variety, especially as the demand is increasing for fancy stock.

One should not judge a variety by the fine appearance of picked samples of nuts without considering the quantity in which they are produced. The best variety is one that will produce annually a large crop of the most desirable type of nut. Unfortunately, we do not have all the good qualities in any one variety. We have to choose a heavy producer with a good quality of nut. One important point is that young trees often produce fair sized nuts, but as the trees grow older the nuts

FIG. 36.—Grafted tree which was cut off at time of transplanting and suckering was neglected. Notice the growth of suckers and stunted top as a consequence. (Original.)

become smaller, so one should judge nuts only from trees that have been bearing for a few years. We should also consider the age in which the tree comes into bearing, as great differences exist in varieties as to the age they begin bearing. The next important consideration is the size and weight of the nut. The commercial No. 1 grade walnuts, as graded by the California Walnut Growers' Association, are those which will not pass through a one and one-sixteenth inch opening in the screen; while those above one and three-sixteenths inch, if smooth and of regular shape and not abnormally large, are considered as budded nuts, which bring considerably more per pound, and the demand is growing for this quality of nuts. Those that pass through the one and one-six-

teenth inch opening are called No. 2, and are generally cracked for marketing.

The weight of the nut is equally important, since this varies widely in nuts of the same size. Some of the largest varieties are considerably lighter in weight than others in which the nuts are smaller. A desirable nut should be well filled with the plump white meat without too much air space between the shell and the meat. A comparatively heavy shell is more desirable than a very light one, since the nut is better protected from being crushed in handling and less susceptible to perforation disease, which is one of the most serious troubles of the walnut grower

FIG. 37.—Third season's growth of transplanted tree—Eureka on first generation hybrid root. As Mr. Shamel says: Individual tree records can be compared with the Babcock test for dairy cows and trap nests for laying fowls. (Original.)

in recent years. This consists of a non-development of the outer hard layer of the shell. The hard shell is not actually perforated, but rather fails to develop. This disease has become more prevalent in the last few years and affects principally the walnut with very thin soft shells, the ones with harder shells not being affected. Nuts that are prone to crack easily and have a fine light shell are more or less injured in handling, thus contaminating the nut. A variety in which the nuts are decidedly uniform is easily distinguished and recognized even by the consumer, and has a marked advantage over one in which the nuts are of all sorts of shapes, so that only an expert could distinguish the variety from others.

The color of the shell is not important, as the trade demands bleached nuts even though they may have an attractive appearance without bleaching. Bleaching brings them all to about the same color. The quality of the meat is of considerable importance, however, as nuts with the lightest colored meats are considerably more desirable, while those that are dark, even though plump and of good flavor, are discriminated against. There is no doubt that the dark meated varieties will become more objectionable as more of the lighter colored ones are produced. The flavor of the meat varies considerably in the different varieties and is of much importance in a high class fancy trade. Commercially there is not much importance placed on their flavor, except when they are bitter. This is the most undesirable quality and should be guarded against in choosing the variety and to formulate an idea of what will constitute an ideal walnut.

FIG. 38.—Economical way of watering young trees. When the tree receives enough water the end of the hose is pulled up higher than the tank by the rope over the pulley on the end of the upright—then the wagon is taken to the next tree. (Original.)

The most important qualifications in a variety from a strictly commercial standpoint are that it should be a uniformly large producer of nuts, the majority of which will not pass through a one and three-sixteenth inch mesh, well sealed even though hard shelled, and should be uniformly well filled with meat of light yellowish brown color, or not darker than light brown or amber. For a fancy trade the nut should be of an attractive uniform shape and color, with a fairly smooth surface, agreeably flavored meat, and no bitterness.

The next important consideration is the choosing of a variety that is resistant to blight, a bacterial disease which affects the young growth when it first puts out in the spring and requires for its development moist weather conditions. Blight is not as yet very prevalent in northern and central California, on account of the drier atmosphere, and also because the groves are young and have not as yet been infected

with the blight. For many years there was no blight in southern California, but it is sure to come into any locality in time. While not very prevalent in northern and central California as yet, still in localities where the infection has been introduced, varieties such as the seedling trees have considerable blight; the seedling groves in the southern part of the State did not become infected with blight until about 1891 and netted very profitable returns, but in the next decade it spread through the southern groves to such an extent as to cause serious alarm. Although we have little blight as yet, it behooves a planter to give due and timely consideration to walnut blight in selecting a variety.

The varieties that do best in the lower San Joaquin Valley are the Eureka, Franquette, Payne's Seedling, Meylan, Mayette, Parisienne, Concord and the Willson Wonder, in the order in which they are named, I am not sure that the Placentia Perfection may not prove itself a good nut for this locality.

Eureka.

The Eureka heads the list when we consider all the qualities. While it is not quite as ideal a nut as the Franquette or Mayette, it is almost as good and bears with me about twice as heavily. It is a vigorous grower and coming out late in the spring renders it the most blight resisting tree we have. The original Eureka tree in southern California has stood all these years closely surrounded by seedling trees which are badly infected by blight, but it is a rare thing to find a nut on the Eureka tree infected with blight. Being late, it also avoids the late frosts and going dormant early in the fall, ripens its nuts earlier than the Franquette and hardens its foliage so that it is not affected by the late fall frosts. It has an abundant foliage and has the habit of growing its nuts in and under the leaves, thus protecting them from the hot sun. Being a vigorous grower and heavy producer, it must be planted in a good deep soil, with good moisture conditions to support the vigorous growth and fill the nuts.

Franquette.

The Franquette is the best nut that we produce today, although it is not a heavy enough producer to be the big money maker, as the nuts will not bring any more than the Eureka, Mayette or Placentia Perfection. In the fall the Franquette ripens its nuts the last of all—often during the rainy season—and going dormant so late sometimes gets caught by the early fall frosts. It comes out late in the spring and avoids the spring frosts and is not subject to blight here.

Payne's Seedling.

Considering the bearing qualities, it is a question if the Payne's Seedling will not prove a better nut for this section than the Franquette. It was originated by George Payne near San Jose. It is shaped very much like the Franquette, but the shell is much rougher and it does not have the salmon color of the Franquette. It is well filled with white meat, is very precocious and produces well, coming into bearing as early as, if not earlier, than the Eureka. It comes out early in the spring, making it liable to be caught by the early spring frosts, and subject to blight. Under blight conditions it blights very badly. On the older trees the nut has a tendency to be a little small.

Meylan.

The Meylan is a French variety of the Mayette type, coming out late in the spring. It is a beautiful nut, well filled with light colored meat of good flavor. It bears in this vicinity a little better than the Mayette but does not begin to compare with the Eureka or Payne's Seedling.

Mayette.

The Mayette, strictly speaking, is of the Grenoble type and is the leading walnut on the world's market. It comes out the same time in the spring as the Eureka and ripens its nuts at the same time. The Mayette is a more shy bearer than the Franquette.

Parisienne.

The Parisienne is one of the French varieties, and is a very good nut. It is rather long and pointed somewhat like the Franquette, but is broader in the center. The shell is not salmon colored like the Franquette, Mayette and Meylan, but is lighter. It is fairly well filled with white meat of good flavor and comes out very late in the spring. In this valley it is a shy bearer, being about the same as the Mayette.

Concord.

The Concord is a seedling of the Cluster variety originated by Felix Gillet. It comes out about three weeks earlier than the Franquette and does not blight in this vicinity. It bears fairly heavy and is filled with plump white meat. It comes into bearing early, but the nut is small and consequently will not bring the same price as the Eureka, Franquette or Mayette.

Willson Wonder.

This nut is a Bijou seedling. The nuts are very large and much smoother and better filled than the Bijou. The tree makes a dwarf growth here, is extremely precocious and bears well. On account of its very large size and rough shell it is not considered by the trade as a commercial nut.

There are many varieties that do fairly well here, but those I have mentioned are the leading commercial varieties. The men from the universities of California, Oregon and Washington, as well as from the Pomological Department at Washington, and many individual growers have been for years searching high and low for new varieties. I recently traveled through the walnut districts in Oregon and Washington, hoping to find something new among the many French seedlings that have been planted in those states, but failed to find anything better than we have. It will be several years before anything is developed.

PREPARATION FOR PLANTING.

Marking.

Measuring wire is perhaps the best means of marking where each tree should be planted. This is made of annealed steel wire about one-eighth inch in diameter, the length according to the wish of the user. Some use a wire as long as 300 feet, while others in smaller plantings make the wire just the length of the piece of land they have. At each end of the wire is fixed a strong iron ring about 1½ inches in diameter, to be slipped over an iron stake. After driving one stake into the ground, the

wire is pulled tight, then the sharp end of the stake on the other end is driven into the ground a little ways, the top pulled back to make the wire more taut and the stake driven firmly in the ground. Along this wire patches of solder are placed where the trees should be planted, and at this point a stake is driven. In using a measuring wire for laying out the trees on the square it is necessary to get one corner true; then a field of good size can be marked out accurately. Select the side of the field which is to serve as a base of the square, stretch the wire along that and allow sufficient distance from the fence to give the teams room to turn in cultivation. When the wire is thus stretched parallel to the boundary of the field, place a stake at each patch of solder on the wire. This stake will represent the first row of trees.

Begin at the starting point and measure for 60 feet along this row with a tape line and put a temporary stake. Then from the starting point measure off 80 feet as nearly at right angles from the first as can be judged with the eye. If the distance between these stakes is 100 feet, then the corner is at right angles. If it is not, you can vary your second stake a little one way or the other until you have it at right angles. Once having the outside lines started at right angles to each other, and the stakes driven at each patch of solder as the wire is stretched on each line, one can proceed with the measuring wire and lay off his measurements in rows, if care be taken to have each line parallel with the last, and to put stakes at the patch of solder on the wire. Of course, if the land is hilly, measurements will have to be made from tree to tree.

Definite instructions in marking off, as well as many other points, can be gotten in "California Fruits and How to Grow Them," by Professor E. J. Wickson of the University of California. In fact, this is a book that every one who is interested in horticulture in California should have.

After having staked where each tree should be planted, a marker should be made about seven feet long, having a notch in the middle of one side and at each end. By placing this marker longitudinally in the row with the notch in the middle of the marker over the permanent stake where the tree is to be planted, then placing a stake in the notch at each end of the marker, you can dig your holes where the permanent stake is, or bore a hole and use dynamite to blow it up.

BLASTING.

Blasting should always be done in the fall when the ground is dry, never when the ground is moist, for it will compact the moist earth and make a regular flower pot, which will be difficult for the roots to penetrate; but blasting done in the summer when the ground is dry, loosens it up thoroughly. Blasting loosens up heavy clay sub-soil or dense stratas of hard-pan underlaid by free soil, so that it takes water well and gives the roots a chance to permeate the ground easily. In many loose soils, I think there is no advantage in blasting. Full directions in regard to dynamiting can be had by writing to the numerous powder companies.

I have seen trees planted in blasted holes that showed no advantages over trees that were planted in holes without blasting, in the same field and planted at the same time in loose soils. On the other hand, in heavy

clay sub-soil or where there is plow sole or hard-pan. I have seen trees planted in blasted holes that made two or three times the growth of the trees planted in non-blasted holes. By allowing these holes to remain open, sun and air permeate into the earth and by planting time the chunks of earth blown out by blasting will be in a finely pulverized condition. The first rains get deeply into the earth and settle the soil which has been loosened up by blasting. If blasting is not done, the hole should be dug at least 2 feet by 2 feet by 2½ feet deep.

PLOWING.

Before planting a walnut grove attention should be paid to leveling the ground. Any little high places should be scraped off and all sags filled in. The ground should be graded so that in irrigating there will

Fig. 39.—A seven-year-old Eureka grove.
(Original.)

be an equal distribution of water. Drainage should also be considered in preparing the soil, as after the orchard is planted it is inconvenient and sometimes impossible to put the land in shape.

Having chosen your soil, it should be plowed deeply and harrowed until it is in a fine state of cultivation. It is well to plow under a good heavy cover crop the spring previous and allow the ground to lie fallow during the summer; but as time is one of the elements in producing a walnut grove, one can not always do this.

PROPAGATION.

The best way to produce a paying orchard of walnuts is to plant nursery grafted trees. A few years ago it was thought the proper way was to plant three or four nuts in the spots which the trees were to occupy in the orchard, pick out the most vigorous tree that started from these nuts and graft to the desired variety of English walnut later on. Theoretically this sounds very well. However, I know of no instance in which this method proved satisfactory, as in some places there would be no trees developed and in others each nut would produce a good tree. Another method which is better, but yet unsatisfactory, is planting the Black walnut seedlings in orchard form and top grafting later. The disadvantage of this method is one common with that of planting the nuts in place, namely, that it is impossible to obtain a uniform stand by grafting the first year, and it will probably take three or four years before all the trees have good tops, thus making your orchard uneven. Then, too, with top grafting on vigorous roots the grafts grow very rapidly and thriftily, making them top heavy and easily blown off by the winds, adding considerable expense and much work to keep your grafts from blowing out. The best way to top graft in the fields is to let the trees grow a few years until they attain considerable size, then graft about one-third of the tree each year. It will take three years to work your trees over, but you will not have the trouble of their blowing off and will not shock your tree. It is not much of a shock to a one-year-old tree to cut it off and graft it, but the older the tree the more shock it produces to cut off all the top by grafting. When you figure the time and expense of top working your trees in the field you will find that they are much more expensive than planting nursery grafted trees. Then, too, the scientific nurseryman does not graft any but his best trees, and if they do not make a good growth after being grafted in the nursery they are rejected. I know of several besides myself who have tried top grafting in the field, as well as planting nursery grafted trees, and I have yet to find the man who has tried this on any large scale who would plant anything but nursery grafted trees. Of course, a small percentage of nursery grafted trees that are transplanted will fail to grow and will have to be replaced the following season. These failures are so few under proper conditions that they are not noticeable in the orchards.

PLANTING.

After choosing your variety on the proper root stock, have them shipped to their destination, obtain and heel them in as soon as possible after their arrival, even if you do not intend to plant them at once.

To heel your trees in, dig a trench deep enough to receive the entire root, so that they may be covered thoroughly at the same height they stood in the nursery. Remove all packing and lay the tops all one way. Cover thoroughly with moist dirt and pour water over them to settle the dirt between the roots. Then put more earth on top. Trees should not be left lying around with the roots exposed.

DIGGING.

If possible, the holes should be dug just ahead of your planters. If this is not possible, the sides of the holes should always be freshly pared off before the trees are put in, and the soil in the bottom of the hole

thoroughly loosened up with a shovel. In digging the holes, the top soil should be placed to one side and the dirt from the bottom of the hole placed on the other side. Replace the marker on its end pegs.

The notch in the middle of the marker will be the proper position for the tree. Cut back all bruised roots to a sound place with a sharp knife and make a fresh, clean, slanting cut on the under side of each root. Place the tree in the hole with the trunk resting in the center of the notch of the tree marker. Spread the roots out in their natural position in the hole in which they are to be planted. The tree should be placed with the same side towards the sun as it stood in the nursery. Let one man hold the tree with the stem in the center of the notch, while the other man slowly shovels in first the top earth, and then that taken from the bottom of the hole, being careful not to place any straw or manure around the roots, as this will leave air spaces and is death to the tree. The earth should be tramped thoroughly, being careful not to bruise the roots with your boots. The top six inches should not be tramped but should be filled in a few inches higher than the surface of the ground, so that when the rains settle the dirt, the tree will not be in a hole a few inches below the surface.

Previous to planting, the top should be cut off to about 12 inches above the ground, according to the number of buds on the lower trunk of the trees, and the cut waxed. I prefer to do this myself before shipping the trees as it lessens the bulk and the cut is waxed, a thing the planter is apt to neglect. After these buds make a growth of 4 to 6 inches, I select the most thrifty one to make the butt of the future tree and pinch off the others. This tree will probably make a growth of 4 to 12 feet the first season and should be tied loosely with baling rope to a stake as it grows. For this purpose I use a 2x3 Oregon pine, 10 feet long, with the lower end sharpened, then dipped in a drum of boiling crude oil for a few moments, using an old oil drum from which I have cut out one of the heads for this purpose. This prevents the Oregon pine stake from rotting and also prevents evaporation of moisture up through the stake. Oregon pine so treated will last three or four years, which is as long as you will require it, and it is much cheaper than redwood.

If the trees are planted late it is well to add ten to twenty gallons of water to settle the earth around the roots. The top six inches of the surface should always be left pulverized and not tramped. In planting, if your soil is too wet, stop until it is in proper condition. It is all right to keep your trees heeled in until the soil is in proper condition for planting, for if they are planted in mud, it will surely bake and they will not do well.

It is useless to plant during the cold months of the winter, as the roots will not start to grow and are liable to become sour from the cold, damp earth, but in the spring when the ground begins to get warm, it is natural for plant growth to put forth. Roots should be about 18 to 20 inches long. If too long, they rot, due to soil being too cold and wet below that depth.

CARE OF YOUNG TREES.

The next and most important thing in hot climates is to nail a shake on the south side of the Oregon pine stake to shade the tree from the hot sun during the middle of the day, the edge extending out beyond the

tree. The stake is driven on the west side of the tree on account of our prevailing winds coming from that quarter. By having the tree cut back to about 12 inches above the ground, you equalize the top and the roots, which have also been cut off, and avoid having the tall top draw more moisture than your limited root system can supply, making the circulation of sap sluggish.

The thrifty new shoot which you select to make the butt of the future tree will have an active sap supply and will not sunburn. This treatment of the newly planted tree in hot climates is most important, for though they may not show it to the naked eye, one that is headed high—say 4 or 5 feet from the ground—without any protection, will be more or less sunburned and the tree does not fully recover from it for a long time.

Cutting back the top makes the tree prone to sucker badly. These suckers and limbs should be kept cut off, except the one selected to make the butt of the future tree. This suckering should be done after the buds begin to swell and repeated every ten days at least three or four times until the suckers stop coming. If allowed to grow these suckers get the first sap and limit the growth of the top buds or stop its growth altogether. At the time of suckering the tree should be hoed around, as it is necessary to dig down 4 or 5 inches below the surface of the ground to reach all the suckers. These should be cut off with a little of the bark of the old roots in order to get all the blind eyes that are surrounding the sucker. If they are only broken off or the blind buds are not removed they will immediately start to grow.

If you wish your trees to make the best growth possible, another important point is that trees thus transplanted should have an irrigation of 10 to 12 gallons of water about every three weeks during the first summer, according to the moisture conditions. The cheapest way to do this is to have a large tank on a wagon with a large hose 1½ inches in diameter connected with the bottom of the tank, which is used to run the water around the tree. The end of this hose can be pulled up above the top of the tank by a string over a pulley on the end of a stake which is higher than the tank and extending out from the wagon bed. Then when you are along beside the tree, lower the end of the hose until the proper amount of water runs out; then raise the end of the hose by pulling on your string and drive to the next tree. By having a gasoline engine to fill your wagon tank, one man can water a great many trees in a day. One man should go ahead and dig a little ditch around each tree to receive the water, after which the dirt should be hoed loosely around the tree, or, what is better, one can place a mulch of straw about 6 inches deep for several feet around the tree. In this way you avoid the hoeing and conserve the water that is applied to the tree much better. By following the detail I have just described one will be well repaid with the amount of growth that the tree will make.

INTERPLANTING.

When walnut trees are planted at such wide intervals as 50 to 60 feet and are somewhat slow in coming into bearing as compared with some other trees, it is generally advisable to interplant with some tree, or plant some crop to get revenue while the nuts are coming into bearing. This is not especially objectionable, as the walnut is a deep rooted tree, provided you do not grow your crop too close to the walnut tree. It is an admirable plan to replace vineyards and unprofitable orchards

by interplanting with walnuts. One should not by any means grow anything within 6 or 8 feet of a walnut tree, and as it gets larger it should be given more room each year. I do not advise strongly, however, to interplant walnuts with other fruit trees, as by the time that both come into bearing it is too much of a drain on the soil and moisture conditions and the development of the walnut grove is delayed. It is much better to grow some annual crop, such as beans, sugar beets, berries, alfalfa, or corn. Of course, when one interplants one must be prepared to furnish that much extra irrigation or the walnut trees will be starved to that extent. Perhaps the most remunerative intercrop is alfalfa, if you have the capital to stock your place with either hogs, sheep or cattle. In this way you get full value of your alfalfa. Hogs are the best as they do not injure the young trees, and if you can raise corn on a portion of your orchard to fatten your hogs in the fall you will get ideal results. Sheep are apt to gnaw young walnut trees and cattle will brush and rub against them. Another very good way is to interplant your walnuts with an early fruiting variety. If you have your permanent crop of Eureka, Franquette, or Mayette, you can interplant with Placentia, Ware's Prolific or Neff's Prolific, which are varieties that come into bearing very early and can be cut out after your permanent crop comes into full bearing. In this way you have your planting 30x60 feet. The interplanted walnuts will bear about as soon as peaches and give larger returns, although they are nuts that do not bring as good prices as the later varieties in this district.

PLOWING AND CULTIVATION.

The general practice is to plow a grove deeply once a year during the spring if possible, plowing under a cover crop of burr clover or *Melilotus indica*, which will make a good winter growth if sowed in September and irrigated at the start of each season. The September irrigation is also an advantage in helping the hulls to crack open and the nuts to drop. The ground should be thoroughly cultivated and a good mulch produced after each irrigation.

PRUNING.

As a rule the second year the trees will not make so much growth in height but will throw out side branches. If they fail to do this they should be topped about 7 feet above the ground. This will force out the side branches. Any limbs that are too low and that cross each other should be cut off. When the tree has a tendency to grow away from the wind the limbs on that side should have about one-third of their length cut off. This will force the tree to grow up against the wind. By topping back one-third of their length on trees that are old enough to bear, but have a tendency to grow too much wood, you can encourage them to throw out fruit spurs. The center of older trees should be kept open to allow the sun and air to go through the trees.

HARVESTING AND MARKETING.

Under proper conditions when the nuts are mature the hulls crack and the nuts fall on the ground. In dry localities it is often advisable to give an irrigation about the time the hulls should crack. The moisture from the irrigation hastens the cracking. This irrigation also pre-

pares the ground for the seeding of your cover crop if you desire one. If a few of the nuts do not drop they are easily removed by shaking the limbs with a hook attached to a long pole. Then they are picked up and put in sacks, and spread on trays in a shed or in the shade to dry. Then they can be bleached, dried again, and sacked for market.

The demand for fancy grade walnuts in this valley is so great that the local trade takes more than we can produce, even at higher prices than the California Walnut Growers' Association pays for better nuts. It will be only a short time, however, until our production will be of sufficient quantity to affiliate with advantage with the California Walnut Growers' Association, for no one with intelligence and sufficient finances to produce a bearing walnut grove will be so blind as not to take advantage of such an opportunity.

The California Walnut Growers' Association has been most successful through the efforts of its President, Mr. C. C. Teague, and its Secretary, Mr. A. C. Thorpe, who are men of long and large experience in citrus as well as walnut marketing. With 75 per cent of the walnut growers behind the association, it is enabled to guarantee every requisite demanded by the trade. We must profit by the experience of others. Look at the condition of the peach and grape growers without organization! On the other hand look at the citrus and raisin growers with their organization. Eight or nine years ago wholesale jobbers were afraid to buy raisins more than twenty-four hours ahead at one time. There was no organization. It was every fellow for himself. But now, due to the Raisin Association, these buyers purchase a year's supply at one time. They have profited by the experience of others. This year the California Walnut Growers' Association handled about 75 per cent of the crop of the State. Last year they handled 65 per cent of the crop at a total cost to the growers of about 3 per cent, including advertising, salaries, etc. They have made standard grades and pack, and sell entirely through brokers' connections, of which they have more than one hundred in the United States. They have more than twenty local associations affiliated with them. I hope it will not be long before the San Joaquin Valley affiliates with them. These associations are located in the different producing sections. The local growers are members of the local association and the local association has representatives in the councils of the head association. The association owns and supplies its own graders, buys bags, twine, etc., at a minimum price for the local association, thus assuring absolute uniformity in grading and packing. They make immediate payments to the local association of 90 per cent of each shipment as soon as shipped, the 10 per cent being held back to pay the expense of advertising, sales, and possible loss, also to equalize the pools—the sum which each shipper gets in case there is a carry over. Under this system favoritism is impossible. Besides this they have their representatives in Europe as well as in the different sections of the United States, are thoroughly familiar with all walnut conditions, and consequently are in a position to handle their product to the best advantage. How different from many perishable crops which you raise, and then sit idly by and allow your income to be decimated by unorganized market conditions. This, with the fact that a properly cared for walnut grove of the right varieties in full bearing and under proper conditions should easily net $300 per acre, makes walnut culture in the lower San Joaquin Valley look most promising.

AN OPEN SEASON FOR THE MONGOOSE.

By Frederick Maskew.

The illustration accompanying this article is a photograph of a mongoose. To the best of our personal knowledge and belief it is the only mongoose in California, and much to our comfort it is dead; also, it is stuffed, which is still better for purposes of observation and photography. The object of this article is partly educational and partly to complete the records of the Horticultural Quarantine Division. The educational feature will be accomplished if the impression made upon the retina of those who look upon this illustration remains fixed and available for reference and comparison at such times as they feel impelled to give publicity to their illusions that a mongoose is loose in California, and start the quarantine inspectors out on a wildgoose rather than a mongoose chase. The mongoose has often—in other countries—been indirectly connected with purposes of horticulture, but in this instance it was directly connected with the same in that the horticultural statutes of the State provide for its exclusion. The quarantine inspectors, to whom the language of the statute is both the law and the gospel, upon hearing that a mongoose was loose, followed

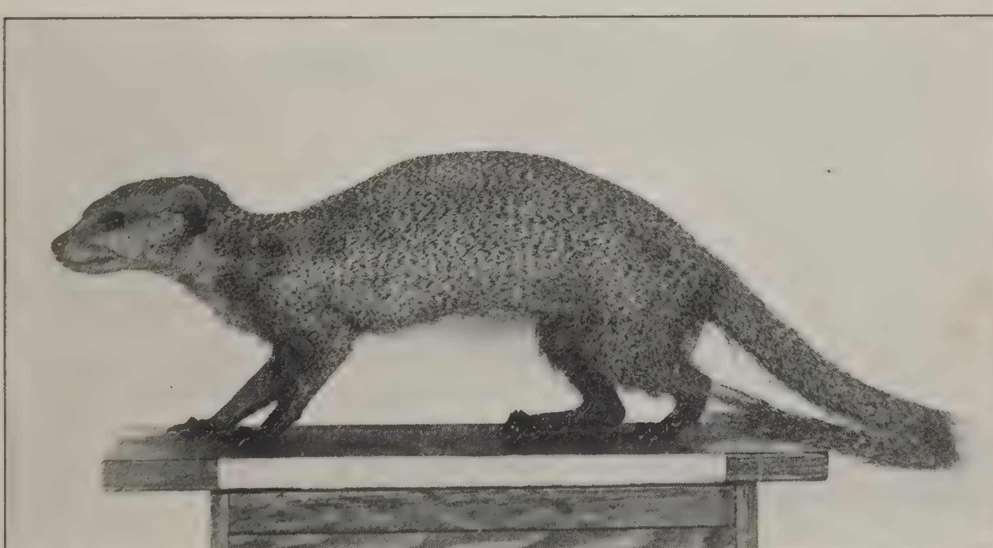

Fig. 40.—The Mongoose (*Herpestes mungo*). (Photo by L. A. Whitney.)

the matter to a conclusion. As no provision is made in the official reports of the division for such occurrences, the same not being horticultural imports, this article is necessary to complete the record of the transactions.

Through the courtesy of Professor Warren T. Clark we received a letter signed by Mr. Eugene Pence, dated January 27, 1915, calling attention to an article published in a San Francisco newspaper of the same date, which set forth that a mongoose had escaped from its owner in Fruitvale and was at liberty in California. The letter dwelt at length on the disastrous results that had invariably followed the introduction of the mongoose into other countries, and with a clear knowledge of these facts ourselves we desire to herewith officially thank Mr. Pence

for the prompt interest he took in this matter. Such applied interest is capable co-operation, and as executive head of the Quarantine Service I most earnestly wish there were more citizens of this same calibre. However, the gist of this paragraph is this: Despite our most diligent endeavors we could not establish a fact nor advance this story one step beyond the shadowland of a myth or the standpoint of a hoax.

On May 13, 1915, the newspapers again reported that a mongoose had passed through the quarantine lines, and worse still had escaped from its owner. No mistake this time, the exact location was given—a hotel on --------- street. However, there was a ray of hope; the animal was reported to be throwing bed clothes out of the window. Those who know the mongoose best and have seen it on its native heath, or rather "Dungaree Green," of a Sunday afternoon engaged in bringing to an abrupt close certain forms of serpentine life, are entitled to entertain serious doubts of its ability to perform any such feats as above reported. Nevertheless, as in duty bound, we pursued this clue to the end and located the animal in charge of the proper official at the San Francisco pound. A harmless little Kinkajou from Mexico! No wonder it had passed the quarantine lines. "The poor little beast is in a tight place; may all good fortune attend him; he is outside our jurisdiction," I said to my deputy, George Compere, and the incident was closed.

The foregoing stories went the rounds of the press and created some apprehension, to judge from the correspondence we received on the matter; also, the same was justified. The establishment of the mongoose in California would mean ultimately the annihilation of our ground-nesting birds and serious interference with the poultry industry. This is not a supposition. It is a fact that has followed in its fullness and entirety the introduction of this animal into the West Indian and the Hawaiian Islands. The following excerpt taken from the Year Book, United States Department of Agriculture, 1898, page 94, corroborates the above statement:

> "Still the mongoose increased, and its omnivorous habits became more and more apparent as the rats diminished. It destroyed young pigs, kids, lambs, kittens, puppies, the native 'coney,' or capromys, poultry, game, birds which nested on or near the ground, eggs, snakes, ground lizards, frogs, turtles' eggs, and land crabs. It was also known to eat ripe bananas, pineapples, young corn, avocado pears, sweet potatoes, cocoanuts, and other fruits. Toward the close of the second decade the mongoose, originally considered very beneficial, came to be regarded as the greatest pest ever introduced into the island. Poultry and domesticated animals suffered from its depredations, and the short-tailed capromys (*Capromys brachyurus*), which was formerly numerous, became almost extinct except in some of the mountainous districts. The ground dove (*Columbigallina passerina*) and the quail dove (*Geotrygon montana*) became rare, and the introduced bobwhite, or quail, was almost exterminated. The peculiar Jamaica petrel (*Aestrelata caribbaea*), which nested in the mountains of the island, likewise became almost exterminated. Snakes, represented by at least five species, all harmless, and lizards, including about twenty species, were greatly diminished in numbers. The same thing was true of the land and fresh-water tortoises and the marine turtle (*Chelone*

> *viridis*), which formerly laid its eggs in abundance in the loose sand on the north coast. The destruction of insectivorous birds, snakes, and lizards was followed by an increase in several injurious insects, particularly ticks, which became a serious pest, and a Coccid moth, the larvæ of which bore into the pimento trees. In 1890 a commission was appointed by the government to consider whether measures should be taken to reduce the number of the animals, and the evidence collected showed conclusively that the evil results of the introduction of the mongoose far outweighed the benefits rendered to the sugar and coffee plantations."

For the peace of mind of those to whom this article is particularly addressed—the crop producers of the State of California—their Horticultural Quarantine Division assures them that there is not a living mongoose in the State today, neither is there going to be as long as the Quarantine Service is master of the situation at the maritime ports of entry in California; and over and superior to this assurance is the fact that the Federal Government maintains an exclusion against this pest through its Bureau of Animal Industry, and this long capable arm extends to and controls every port of entry in the United States.

RENEWING OLD LEMON TREES.*

By J. D. CULBERTSON, Limoneira Company, Santa Paula, California.

The announced subject of this paper is "Renewing Old Lemon Trees," but we shall attempt nothing more than a discussion of heavy pruning in its relation thereto. Though ordinarily subordinate to the four indispensable needs of irrigation, handling of the soil, pest control and food supply, the pruning problem may in some cases and at certain times in the life of a tree be of pre-eminent importance. This is not an attempt to tell just how to renew a declining orchard—we would not be so presumptuous as to try to tell others how to do what we ourselves do not know how to do. Rather, we bring you only a few fragments of data gathered from a pruning experiment on the Limoneira Ranch at Santa Paula, an experiment conceived and suggested by its manager, Mr. C. C. Teague.

First we enumerate somewhat in detail the symptoms of decline in a lemon orchard as we have observed them, not all of which, however, appear simultaneously in each and every tree in a given orchard.

Perhaps the most common symptom, be the crop large or small, is the tendency to produce a high percentage of fruit which habitually matures undersize, despite generous fertilization, resulting in an undue proportion of ripes, and small sizes overabundant, not only in the ripes but in all of the better grades as well. This forces a larger proportion of the fruit to sell at a discount—some of it possibly not at all—besides causing greater expense in handling and packing, and loss due to heavier decay.

To this poorer quality is often added the loss from greatly reduced yield. Frequently many lemons hang far out on the ends of rather

*Address before the State Fruit Growers' Convention, San Bernardino, California, 1916.

long attenuated fruit spurs. These are always of poor quality, irregular shape, and disfigured by sun and wind scars.

The foliage is usually more or less dwarfed, sparse and of poor color.

Many leafless fruit spurs may be found in all parts of the tree, both inside and out, bearing little or no fruit.

Checking and cracking of the bark of the main trunk often takes place, frequently extending from bud line upward and well out on the main branches. Later this flakes off, exposing a new bark underneath. Many trees appear to be in great distress during this process—a trouble not thoroughly understood, but thought by some to occur earlier on trees that have been consistently heavy producers.

The above symptoms of decline are given with reference to trees supposedly well cared for in every way, and on first-class soil. A very different class of trees, showing many of the same symptoms, consists of trees whose inability to produce fruit of quality has been due to: lack of adequate water; soil impoverished for want of organic matter, resulting in poor physical condition; lack of nutrition, apparently in most cases because of an inadequate supply of nitrogen in proper form; shallow soil underlaid with sand and gravel, incapable of the capillary power necessary to bring back moisture and soluble plant food that have passed through to lower levels during winter rains and irrigation; loss of part of the root system, through injury or disease, or, perhaps more frequently, a similar loss of bark on the main trunk.

Mature fruit trees of all kinds belonging to this latter class have long been known to be greatly aided toward profitable production by liberal pruning, even if the other disadvantages are not removed. Indeed, it was largely from object lessons obtained by pruning trees with such special disabilities that the conviction came to us that, if heavy pruning would so conspicuously improve them, how much more fully might this be realized in a tree not thus handicapped.

Another matchless object lesson was the heavy freeze of January, 1913. A fifteen-acre block of our twenty-year-old trees that had begun to show many of the symptoms of decline was frozen just enough to kill probably 80 per cent of the fruit wood, and many of the larger exposed branches were so injured that the outer portion of the main structure was reduced at least 30 per cent. All cross limbs and unnecessary leaders were removed. It need not be told how these trees "came back." Nearly every community has been a witness to a similar rejuvenation of at least a few lemon trees of mature years. That year's crop was zero, of course, and even during the second twelve months after the freeze we gathered less than two field boxes per tree, though of superb quality. The third year, however, the crop was 10 per cent above any prior yield, and again of highest quality. The present year promises an even greater production, with quality still unimpaired.

One more object lesson may be alluded to. Thirty years ago Mr. Nathan W. Blanchard, of Santa Paula, the well known pioneer in lemon growing, was shipping one hundred packed boxes of lemons per acre from an Eureka orchard planted in the '70s. The trees were allowed to grow very much like seedling orange trees until twenty-six or twenty-eight years old. By that time the symptoms of decline, as we know them today, were very evident, both in the orchard and on the balance sheet in the office. Low heading of lemon trees was being vigorously agitated throughout the lemon growing sections. These considerations led to

a most severe top pruning, so heavy in fact that the crop was cut to 45 per cent of normal. The second year it rose only to 80 per cent, but the third year the yield was 108 per cent of normal quantity, and of such a superior quality that it was probably equal to 150 per cent of the previous normal value. The production has steadily increased to 125 per cent of the original average crop; but now, after an interval of thirteen years since pruning, the fruit sizes are growing smaller and the percentage of ripes increasing—premonitions of the day when another heavy pruning may be necessary.

In the spring of 1914 the performance of much of the Limoneira orchard was so unsatisfactory, with small sizes, ripes, and other evidences of decadence, all calling for correction, that we undertook carefully to investigate the merits of heavy pruning as a last resort, and to determine in relation to it: when it may be done with least sacrifice to present crop; when with least sacrifice to the following year's crop; what effect it might have on the percentage of ripes and small sizes; whether one can prune at such a season that the first succeeding crop will mature its fruit for the summer market, thereby compensating for loss in quantity by increased value; what type of cuts should be necessary and best suited to the purpose, and also how much cutting to do; what the expense would be, and how difficult the task of training men for it; and what precautions to observe in an orchard-wide policy of heavy pruning, should this seem advisable later.

In brief, our method was to reduce the mean radius of the tree very little, but to remove all cross limbs, superfluous leaders and out-hanging corners, and relieve top-heavy boughs by heavy concealed cuts, avoiding as much as possible "heading" and the leaving of "holes" in the sides of the tree. The result was a sacrifice of perhaps 60 per cent of the foliage and 30 to 40 per cent of the fruit spurs—wood less than one-half inch in diameter. For the experiment we selected the block of Lisbon orchard most in need of rejuvenation. All rows were picked just before pruning. Row 1 was reserved as a check to be given our customary prunings; row 2 was pruned in May; row 3 in June; row 4, a check; then July and August and another check, and so on: one row for each month for twelve successive months, with eight check rows so arranged that each pruned row had a check on one side of it.

Records of production were kept beginning January 1, 1914, showing monthly yields from each of the twenty rows to be included in the experiment. Taking the calendar year as the crop year, the accompanying chart shows the percentage of crop harvested from each row during the year when the pruning was done. It also illustrates graphically the percentages of crop harvested during the next crop year. To obtain these percentages all yields were compared with the corresponding year's average yield from all check rows taken together as the normal 100 per cent yield, and reduced to the basis of pounds per bearing tree. By arranging the first year's record at the left of the chart and the second year's record at the right we see at a glance the blank areas which, taken together, show the combined percentage of crop lost during the two crop years.

To be complete, these data should extend over a three to four year period in order to include at least one full crop following the years of sacrifice. But without this complete data some tentative conclusions may be drawn as to the season when heavy pruning may be done with

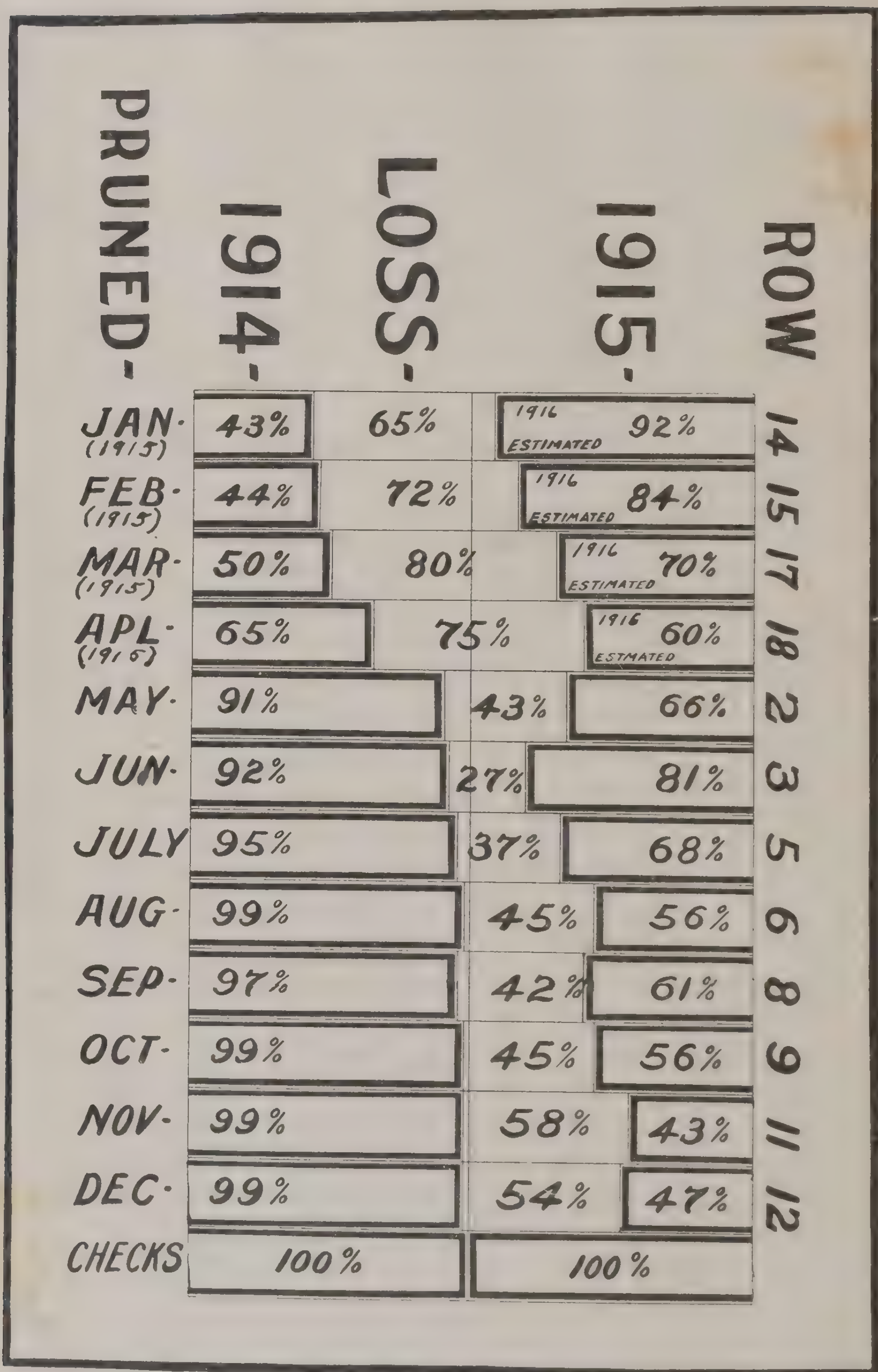

FIG. 41.—Chart showing records of production of lemons. (Original.)

the least sacrifice in quantity of fruit. It is fairly evident that it should be undertaken as soon as possible after from 70 to 80 per cent of the crop have been harvested. In our section this would enable us to begin late in May or early June, extending through July, and possibly August. It appears that the heaviest sacrifice results from winter and early spring pruning during the six months from November to April, a season when the trees are laden with a full crop all but ready to gather. In this connection it may be said that while the data as to seasonal yields following pruning are too incomplete for analysis, yet there are strong indications that the heavy sacrifice of yield resulting from the winter and early spring pruning may be quite largely offset by a goodly production of high quality summer fruit.

A comparison of the ripes reveals the fact that during the second crop year fruit from the check rows graded 30.5 per cent ripe, as against only 16.6 per cent from the first four pruned rows—a ratio of practically 2 to 1.

As to the type of pruning and amount of it, we do not feel that we could improve materially on the general method employed and already described.

Where heavy pruning is undertaken we learned that whitewash should be used freely and promptly to prevent serious sunburn of large limbs and trunk. This is very important. Paint with asphaltum all large cuts, fumigate cautiously when the new growth has just begun, and spray with great care.

Aside from the temporary sacrifice of fruit involved, the expense of such a pruning is considerable. A good man will hardly prune more than eight or ten trees per day, and the cost of hauling out the brush, or cutting it, amounts to several cents per tree, while the cost of painting the large cuts and whitewashing adds at least another five cents.

Trees pruned later than July or early August are apt to put out a short growth that does not have time to fully mature before cold weather comes. As a consequence, it yellows considerably during the winter months, but with the awakening of spring it soon regains a normal color, or disappears beneath the out-pushing free growth of early summer.

From our experience to date, no further pruning will be needed for about a year. Heavy pruning in early summer may, in some localities, call for the removal of a few suckers and long fruit spurs of doubtful value the following winter, if other growers feel, as we do, that the citrus tree, like the deciduous tree, is probably best served by receiving its principal annual pruning during the dormant winter months.

In considering a general policy of attempting tree removal by heavy pruning, or even a small experiment—and the small experiment should always be undertaken first, and in every locality at an early date the grower should be as sure as he can be that the trees do not need food, better or less cultivation, pest control, less water or more. It is doubtful if even the heaviest production will bring a tree to the point of decline before the age of sixteen or eighteen years, if it has been well treated and fed. A possible error with rather young trees may arise through the impression that if a vigorous lemon tree has not borne fruit in abundance by the time it is six or seven years old it never will. There appears to be a strong growing strain of lemon tree, of a variety perhaps not definitely placed, which, though late in commencing, yet in the

end becomes a heavy producer. It may not be a desirable type to propagate and plant henceforth, but he who has such an orchard just on the point of profitable production, should hesitate before deciding that it must be "renewed" with pruning shears. More likely it needs fertilizers and organic matter.

Our conclusions, based on the evidences and data thus far, have led us to prune first a ten-acre block in June, 1914, and some forty acres more in the summer of 1915. When an old orchard grows like a young orchard, it produces fruit like a young orchard—and truly, the trees pruned now almost two years ago are growing like young trees.

Undoubtedly the most desirable means of renewing lemon trees would be a thoroughly understood method of regular annual or more frequent pruning by which the tendency of trees to fall into slothful and enervated performance would be steadily counteracted. Perhaps there are growers who fully believe this can be done, and there are orchards at the present time twenty to thirty years old which may appear to be strong examples in support of such a belief. However, variations in soil, cultural methods, fertilization, quality, quantity and method of application of irrigation water, location as regards protection from or exposure to frost, winds and sun, adaptability of varieties, variations in tree types due to source of buds or stock—all of these factors are as yet inseparably involved in the study of every orchard. Only after reliable demonstrations under each and all of these varying conditions, and covering a period extending well into the next generation, will it be possible for any one to say whether or not the annual pruning could be so done that trees will not become superannuated.

CROP REPORT AND STATISTICS.

THE ACREAGE OF FRUITS, BEARING AND NONBEARING, BY COUNTIES, IN 1915.

By Geo. P. Weldon.

In the December number of The Monthly Bulletin for 1914, a table showing the acreage of fruit trees by counties was published. This was the first comprehensive table of the kind that was ever compiled by the office of State Commission of Horticulture, and it was with a realization of the fact that such a table could not be perfect that it was published. Subsequently a series of maps were made from this table, which showed graphically the counties producing each kind of fruit and the relative importance of each county. These maps were exhibited at the World's Panama-Pacific International Exposition, in the Palace of Horticulture, as a part of the exhibit of the State Commission of Horticulture.

As expected, there was some criticism of the figures in a very few cases, but on the whole much less than was expected. A searching investigation in cases of the most severe criticism revealed the fact that the parties taking exception to the figures had nothing better to offer, and consequently very few changes were found to be necessary.

With the 1914 table as a basis for future estimates, the county horticultural commissioners, who have done splendid service in this work, carefully revised the figures for 1915, that are given in the table which follows. This table we believe is the most complete and accurate table of the kind that has ever been printed. In a few cases it has not been possible to get as accurate statistics as we had hoped might be available. For example, Fresno County, with a very large acreage of fruit and a tremendous amount of work for a county commissioner, was not able with the limited help and time to make a careful census in 1915, and the figures which appear in the table were in most cases compiled by the Raisin Exchange in 1914. Solano County, one of the important fruit growing counties of the State, is very unfortunately at present without a county horticultural commissioner, and although repeated efforts have been made to get figures from other sources, they have been of no avail and former Commissioner McBride's estimates of acreage, bearing and non-bearing, for 1914, are used again this year.

In general the figures given can be depended upon as fairly accurate. This statement is made after a careful investigation into the methods employed by the various county horticultural commissioners in doing the work. It was found that in many counties an actual tree count has been made. This in each case has been reduced to an acreage basis by estimating so many trees per acre. This, of course, may bring about a slight discrepancy, as the acreage will depend on the number of estimated trees per acre, but in all cases a fair average has been taken and there should be no bad errors. Hasty publication has been avoided, and all doubtful figures brought to our attention have been carefully investigated.

CROP STATISTICS

County	Almonds		Apples		Apricots		Berries		Cherries		Figs	
	Bearing	Non-bearing	Bearing	Non-bearing	Bearing	Non-bearing	Bearing	Non-bearing	Bearing	Non-bearing	Bearing	Non-bearing
Alameda	385		130		5,333	980	95		1,000	160		
Butte	2,000	1,500	500	400	85	20	80		85	35	155	80
Colusa	300	2,500			30	15					20	
Contra Costa	1,750	1,000	160	96	500	250	20	20	200	88	20	8
El Dorado			350	225					80	40		
Fresno			250	30	2,137	613					2,919	
Glenn	200	1,720	78	145	200	270					15	355
Humboldt			1,100	450								
Imperial					110	335					52	113
Inyo			800	1,200	20	25						
Kern		130	100	1,957	230	225					14	57
Kings					2,118							
Lake	285	182	242	10	31	2	20		10		10	3
Los Angeles	437		927	650	1,472	441	4,296				84	69
Madera	50		200		200		15				150	125
Mendocino	25	19	450	665	25	45			50	25	20	25
Merced	450	410	70	37	230	110	60		7	10	500	540
Modoc			265	335								
Monterey	10	35	3,000	1,150	800	600	150		10	5		
Napa			400	120	160	90	59	12	350	125	50	6
Nevada	25		1,500	250	15	5	50	10	75	20	20	5
Orange			150	230	1,600	160	200					
Placer	250		450		42		500		350		45	
Riverside	979	426	817	2,522	2,688	3,323	23		29	334	7	16
Sacramento	1,060	750	400	100	490	75	2,000		370	200	10	
San Benito	200	100	400	25	2,500	1,000	300		100	25		
San Bernardino			1,258	6,550	1,652	830			43	80		
San Diego	85	21	1,110	221	113	98			8	10	10	16
San Joaquin	2,000	1,000	20	70	1,000				1,800	700	80	25
San Luis Obispo	150	1,895	345	50	117	240						
Santa Barbara			400	100	150	170			160	125		
Santa Clara	238	75	342	407	8,434	388			1,876	986	46	28
Santa Cruz			15,500	1,100	1,200	1,000	500		150	200		
Shasta	35		228	114	10	7	110		6	7	10	5
Siskiyou	5	1	650	345	15		80		45	30		
Solano	1,000	415			1,300	150			700	300		
Sonoma	106	17	5,007	3,771	582	23	1,500		655	589	102	
Stanislaus	912	1,109	119	5	388	217	85		33	27	346	37
Sutter	1,500	998	157	20	20				42	27	179	
Tehama	500	400	500	50	600	50					100	
Tulare	30	220	375	155	325	350	15	20	10	20	325	685
Ventura					2,016	2,421						
Yolo	3,500	1,100	30		1,900	25	260				300	15
Yuba	135	50	430	75	80	25	50	50	25	25	120	200
Totals	18,602	16,073	38,410	22,430	40,898	14,553	10,468	112	8,269	4,193	5,709	2,413

BY COUNTIES.

Lemons		Olives		Oranges		Peaches		Pears		Plums		Prunes		Walnuts	
Bearing	Non-bearing	Non-bearing	Bearing	Bearing	Non-bearing	Bearing	Non-bearing	Bearing	Non-bearing	Bearing	Non-bearing	Bearing	Non-bearing	Bearing	Non-bearing
4	------	50	------	10	------	40	------	437	250	125	20	1,704	250	100	------
25	30	1,900	2,100	2,000	210	3,000	775	400	------	100	125	2,000	2,000	20	40
------	800	------	------	40	300	300	200	30	20	------	20	1,000	3,000	40	50
5	6	143	5	13	5	600	290	800	917	100	51	1,100	330	30	1,300
------	------	18	15	------	------	300	25	500	1,000	300	550	------	------	10	30
75	------	502	------	1,788	------	35,000	------	------	------	343	------	981	------	159	------
58	320	42	230	75	2,830	150	2,750	25	593	------	------	210	820	5	170
------	------	------	------	------	------	------	------	------	------	------	------	------	------	30	450
13	9	52	143	73	198	32	198	37	103	18	25	------	------	------	------
------	------	------	------	------	------	450	150	250	250	50	75	------	------	------	------
------	------	40	525	450	1,222	660	410	190	992	50	100	200	400	------	100
------	------	------	360	------	------	7,183	------	------	------	------	------	1,109	------	------	------
------	------	45	------	2	------	150	51	1,460	1,000	------	------	833	183	288	304
3,694	4,965	2,100	208	24,407	8,742	2,922	3,614	311	2,388	491	295	229	21	8,901	6,240
------	------	175	690	10	------	550	900	15	------	------	45	75	------	------	47
------	------	10	7	------	------	37	145	255	725	35	------	335	275	10	------
14	10	194	70	49	40	5,000	1,121	85	79	42	44	40	170	35	185
------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
------	------	------	------	------	------	100	------	80	100	------	------	40	25	5	15
12	28	200	------	20	23	500	82	425	235	100	24	3,000	1,200	160	90
------	------	5	------	10	------	350	300	600	1,200	110	240	110	------	20	50
3,000	1,550	386	------	9,806	6,500	50	1,000	------	------	25	------	------	------	12,000	1,900
------	------	320	------	350	------	7,000	------	1,500	------	5,500	------	------	------	------	------
2,586	2,368	1,559	503	16,363	3,112	1,837	1,057	310	638	30	39	490	125	410	1,592
15	20	720	740	950	800	1,880	950	3,000	2,000	1,350	600	690	500	------	150
------	------	------	------	------	------	700	200	350	100	------	------	3,000	1,000	30	150
2,602	2,335	572	652	33,390	7,717	6,703	2,712	115	319	42	31	------	85	649	1,407
3,016	1,664	1,500	74	1,262	114	503	255	118	67	17	37	48	54	116	216
------	20	600	300	20	50	7,000	6,000	800	1,500	500	1,000	600	1,500	200	2,000
10	------	40	------	7	------	50	500	75	3,285	------	------	50	279	106	60
900	350	450	105	5	2	------	------	20	------	------	------	------	------	4,800	800
20	15	135	52	18	11	5,463	375	1,400	185	2,915	162	54,200	4,206	563	196
15	60	------	------	1	1	100	100	50	325	------	------	300	------	------	------
------	------	140	250	5	3	324	454	100	15	25	150	760	130	37	40
------	------	------	------	------	------	175	25	40	10	65	50	15	5	2	12
------	20	20	------	10	20	4,200	600	1,000	230	2,521	1,520	4,345	1,800	------	------
8	2	700	------	106	15	700	419	1,097	554	102	45	7,687	3,004	328	278
7	2	74	45	105	50	3,754	399	138	65	14	75	52	146	20	379
------	------	50	25	------	------	2,352	2,756	221	109	80	3	787	888	15	239
------	------	1,500	450	225	75	3,500	600	350	100	100	------	1,200	500	------	------
32	775	800	3,050	19,750	22,550	7,845	1,500	45	30	450	250	2,550	1,450	10	250
1,713	2,879	212	6	1,386	862	------	------	------	------	------	------	------	------	5,064	1,412
------	------	450	75	60	15	1,950	100	900	125	600	150	1,450	225	40	10
25	------	350	900	160	30	765	300	500	390	260	100	280	200	250	200
18,442	18,228	15,854	11,580	112,9 6	55,527	113,725	31,165	17,779	19,649	16,110	5,751	91,470	21,774	31,153	20,302

THE MONTHLY BULLETIN

CALIFORNIA STATE COMMISSION OF HORTICULTURE.

DEVOTED TO HORTICULTURE IN ITS BROADEST SENSE, WITH SPECIAL REFERENCE TO PLANT DISEASES, INSECT PESTS, AND THEIR CONTROL.

Sent free to all citizens of the State of California. Offered in exchange for bulletins of the Federal Government and experiment stations, entomological and mycological journals, agricultural and horticultural papers, botanical and other publications of a similar nature.

Entered as second class matter December 29, 1911, at the post office at Sacramento, California, under the act of July 16, 1894.

Oregon Quarantines Against California Potatoes.—Oregon has placed a quarantine against California potatoes because of the potato tuber moth which is widespread in California and which does not occur in Oregon, at least not to any extent. Potatoes are admitted into Oregon under certain conditions, which are given in the quarantine which follows:

OREGON STATE BOARD OF HORTICULTURE.

Notice of Quarantine, No. 3.

The fact has been determined by the president of the Oregon State Board of Horticulture that a dangerous insect pest, injurious to the common potato, which is commonly known as the potato tuber worm (*Phthorimœa operculella*, Zell.), new to and not heretofore prevalent or widely distributed within and throughout the State of Oregon, exists and is widespread in the State of California, and that, to prevent the introduction and spread of said pest in the State of Oregon, it is necessary to forbid the importation of potatoes from California except under the conditions hereinafter set forth:

Now, therefore, I, Chas. A. Park, president of the Oregon State Board of Horticulture, under the authority conferred by section 1 of chapter 246 of the General Laws of Oregon of 1913, and section 4 of chapter 342 of the General Laws of Oregon of 1915, do hereby prohibit the importation of any common potato or potatoes from the State of California into the State of Oregon, except under the conditions hereinafter specified, and from and after the publication of this notice in three newspapers published in the State of Oregon it shall be unlawful for any person, firm or corporation to transport or bring any common potatoes from the State of California into the State of Oregon except under the following conditions:

1. Every shipment of common potatoes from the State of California to the State of Oregon must be accompanied by a certificate of inspection signed by a county horticultural commissioner or other duly authorized horticultural inspector of said State of California, certifying that he has inspected the potatoes in said shipment and found them free from the potato tuber moth, its larva or pupa. Such certificate shall be signed in writing and shall specify the locality where said potatoes are grown, the date of inspection, and the number of sacks, boxes or other containers included in the shipment inspected.

2. Every shipment of potatoes grown in California which is brought into Oregon must be brought to the city of Portland, and must be held at the wharf, dock, railroad yards, freight depot or express company's depot or office of the common carrier bringing such potatoes into the state until said potatoes have been inspected by the state inspector of the Oregon State Board of Horticulture or by some other duly authorized inspector working under direction of the said State Board of Horticulture, and permission has been given by the inspector making such inspection to deliver the potatoes. The common carrier, person, firm or corporation bringing potatoes into Oregon which are grown in California must notify the State Board of Horticulture or the State Inspector of said Board of the arrival in Portland of such potatoes and hold the shipment as hereinbefore provided.

3. If, upon inspection, any of the potatoes in any shipment are found to be infested with the potato tuber moth, its larva or pupa, or show indications that they have been so infested, the person, firm or corporation who has brought said shipment of potatoes from California to this state must take said shipment of potatoes back to California within four days from the date of inspection of said potatoes in Portland, provided that if the infestation shall be in such condition that the inspector believes there would be danger of escape of the potato tuber moth from the shipment in course of transit through the State, the person, firm or corporation bringing the shipment into the state will be required to destroy the shipment, including the containers, by burning up the same.

Done at Salem, Oregon, this twentieth day of January, 1916.

CHAS. A. PARK,
President of the Oregon State Board of Horticulture.

I, James Withycombe, Governor of the State of Oregon,
do hereby approve the foregoing promulgation.

JAMES WITHYCOMBE,
Governor of the State of Oregon.

The California peach borer, *Ægeria opalescens*, H. Edw.—In contradiction of the general belief and published statements that the Myrobalan stock is comparatively resistant to the attacks of the California peach borer, Deputy Horticultural Commissioner D. P. T. McDonald and Horticultural Inspector H. R. Hunt of Alameda County report very severe infestation to this stock at Niles, California. The observations made by these officials are of much importance in that Myrobalan stock has been recommended for localities where this insect occurs.

It is also of interest that Horticultural Commissioner A. A. Brock, of Ventura County, has found this insect in the orchards of the Bardsdale district across the river from Fillmore in his county.—E. O. Essig.

REPORT OF THE RESOLUTIONS COMMITTEE—FORTY-EIGHTH STATE FRUIT GROWERS' CONVENTION.

Whereas, There has been rendered at the Forty-eighth Fruit Growers' Convention an extremely interesting and profitable program; be it

Resolved, By the Forty-eighth California State Fruit Growers' Convention in convention assembled, that we hereby express our thanks to Dr. A. J. Cook, State Commissioner of Horticulture, for his preparation of the splendid program presented for our benefit, and for his energetic and successful efforts in carrying it to its fulfillment.

Whereas, Every possible provision has been made for the comfort and convenience of the members of this convention, for pleasant quarters for its various gatherings; be it

Resolved, That we express to the directors of the National Orange Show, the city and county of San Bernardino, and to all others who have aided in its success, our sincere gratitude.

WHEREAS, The State Commission Market, through the able director, Colonel Harris Weinstock, is endeavoring to evolve a plan by which the citrus crop of California will be properly distributed so as to give each market all the fruit that can be used without glutting said market and so as to issue a fair return to the grower; and

WHEREAS, The convention recognizes the need of some such better distribution for the industry as a whole and appreciates the efforts of the state administration and particularly of the State Market Director, Colonel Weinstock, in his efforts to secure a better distribution of the citrus crops of California, which would result in a better return to the grower; and

WHEREAS, The State Market Director proposes to call upon the shippers, buyers, shipping companies and growers' associations to co-operate with him in bringing about a more even distribution of the citrus crop; and

WHEREAS, Gluts and famines mean to the grower at times abnormally low prices and at times high prices; and

WHEREAS, It is in the interest of the consumer that supplies shall be regular and steady, which means to him fair, average prices, instead of abnormally high and abnormally low prices; and

WHEREAS, Gluts mean to the producer great wastage, to his serious loss, and injury; and

WHEREAS, The State Market Director will, in the interest of producer and consumer, strive to prevent gluts and famines in our eastern markets; be it, therefore,

Resolved, That a committee of seven be appointed by the State Horticultural Commissioner to confer with the State Market Director for the purpose of evolving a plan whereby the shippers may legally co-operate with the State to accomplish this desired result and that this committee shall report to the next State Convention of Fruit Growers, or at a special convention to be called by the State Horticultural Commissioner on the joint request of the State Market Director and a majority of said special committee.

WHEREAS, Dr. A. J. Cook, our State Horticultural Commissioner, has for over a quarter of a century rendered valuable service to the fruit industry of California; and

WHEREAS, During this period in which the industry has experienced its most marked development, Dr. Cook, as a citizen, as professor of Pomona College, as director of Farmers' Institutes under the University of California, and as Horticultural Commissioner of the State, has labored with untiring zeal and unselfish devotion in the interests of the fruit growers, making a contribution to the industry worthy of the admiration and gratitude of every fruit grower in the State; therefore be it

Resolved, By the fruit growers assembled in this Forty-eighth State Fruit Growers' Convention, that we hereby express to Dr. Cook our grateful appreciation for his long, faithful and intelligent service in the interest of the fruit industry of California; be it further

Resolved, That the Secretary be requested to send a copy of these resolutions to Dr. Cook.

WHEREAS, The Commissioner of Horticulture, Dr. A. J. Cook, has announced his retirement from office in the near future; and

WHEREAS, It is of the greatest importance to the horticultural interests of the State that a successor be appointed who has a wide knowledge of the horticultural and agricultural industries, who appreciates the necessity of preventing the entrance of insect and fungous pests into the State, and their spread within its borders, and who will maintain the same high standard of practical and scientific efficiency which has characterized the administration of Commissioner Cook; therefore be it

Resolved, That the State Fruit Growers' Convention urge the Governor of California, the Honorable Hiram W. Johnson, to appoint Frederick Maskew, now Chief Quarantine Officer of the State Horticultural Commission, as State Horticultural Commissioner, believing that his long and efficient service through which he has filled temporarily every position in the State Horticultural Commission, his practical

and scientific qualifications, his power of executive ability, his wide knowledge of the horticultural interests and the universal esteem in which he is held eminently fit him for this position.

We desire to incorporate in our report the following resolution:

WHEREAS, Our State Commissioner of Horticulture, Dr. A. J. Cook, deems it imperative, owing to the precarious condition of his health, to relinquish the arduous duties of his office; and

WHEREAS, He has publicly announced his determination to resign his commission in the near future and retire from his present official position to secure a much-needed rest; therefore be it

Resolved, That we, the members of the State Association of County Horticultural Commissioners in attendance at the Forty-eighth California State Fruit Growers' Convention in San Bernardino, February 19, 1916, do hereby express our sincere regret at the retirement of an official head who has always been characterized by his painstaking and conscientious efforts to serve the horticultural interests of this State, in the best possible manner, and who has sacrificed health and comfort in his loyalty to those interests; and be it further

Resolved, That we extend to Dr. Cook our heartfelt sympathy and earnest hope that he will soon be restored to his usual health and vigor and long be spared to assist us by his wise counsel.

CHARLES F. COLLINS, C. W. BEERS,
KENT S. KNOWLTON, H. M. ARMITAGE,
ROY K. BISHOP, D. D. SHARP,
WILLIAM WOOD.

WHEREAS, The Resolutions Committee of the Forty-seventh California State Fruit Growers' Convention held in Visalia in November, 1915, recommended the adoption of a resolution in respect to the appointment of a committee relating to the revision of the horticultural laws through a misunderstanding of the situation; and

WHEREAS, Said resolution was passed by said convention; and

WHEREAS, The resolution as passed was not in the exact form desired; therefore, be it

Resolved, That said resolution be and the same is hereby rescinded; and

Further Resolved, That Dr. A. J. Cook, State Commissioner of Horticulture, be and is hereby requested to appoint a committee of three, including himself, and that said committee of three add to their number, thereby creating a larger committee to act as a standing committee to consider the points embraced in a paper presented by G. H. Hecke to the State Association of County Horticultural Commissioners, relating to a revision of the horticultural laws of the State of California, at a meeting held in Visalia on November 17, 1915, said standing committee to present its report to the Annual Fall Fruit Growers' Convention, and to the Annual Convention of the State Association of County Horticultural Commissioners in 1916.

Signed,
P. F. COGSWELL, (*Chairman*), C. W. BEERS,
C. C. CHAPMAN, G. H. POWELL,
C. C. TEAGUE, F. S. JEROME,
C. F. COLLINS.

COUNTY COMMISSIONERS' DEPARTMENT.

COUNTY HORTICULTURAL COMMISSIONERS, THEIR DEPUTIES AND INSPECTORS.*

ALAMEDA.

Commissioner:
Seulberger, Fred--418 14th st., Oakland
Deputy Commissioner:
Macdonald, D. P. T., 717 Santa Ray st., Oakland.
Inspectors:
Acker, C. H.----------Livermore
Hunt, H. R.----------Niles
Petersen, Edlif----------Hayward
Tyson, W. H.----------Niles

BUTTE.

Commissioner:
Mills, Earl----------Oroville
Deputy Commissioner:
Stile, T. J.----------Chico
Inspectors:
Burleson, W. D.----------Gridley
Pense, W. M.----------Paradise
Reppert, B. F.----------Thermalito
Sargeant, R. S.----------Biggs

COLUSA.

Commissioner:
Boedefeld, L. R.----------Colusa
Inspectors:
Fouch, Ira ----------Williams
Gilliam, F. B.----------Princeton
Hall, Geo. ----------Maxwell
Peart, F. A.----------College City

CONTRA COSTA.

Commissioner:
Swett, Frank T.----------Martinez
Inspectors:
Sellers, Geo. ----------Oakley
Stevens, V. G.----------Walnut Creek

EL DORADO.

Commissioner:
Hassler, J. E.----------Placerville

FRESNO.

Commissioner:
Roullard, Fred P.----------Fresno
Inspectors:
Hurst, Harry----------Orange Cove
Kaufman, E. E.----------Kerman
Oliver, O. ----------Sanger

GLENN.

Commissioner:
Ley, Carl J.----------Willows

HUMBOLDT.

Commissioner:
Weatherby, Geo. B.----------Eureka
Inspector:
Vorrah, E. D.----------Eureka

IMPERIAL.

Commissioner:
Waite, F. W.----------El Centro
Inspectors:
Henson, W. E.----------Bard
Phelan, Fred----------El Centro

*Corrected to March 1, 1916.

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Nordyke, E. M.----------Bishop

KERN.

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Knowlton, Kent S.----------Bakersfield
Inspectors:
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Joos, Harry E.----------Inyokern
Kanstein, L. J.----------Tehachapi
Lavers, Laurence ----------Wasco
Pitts, D. W.----------Tehachapi
Schultz, Norman P.----------Delano
Williams, Paul ----------Bakersfield

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Commissioner:
Howard, Fred K.----------Hanford

LAKE.

Commissioner:
Stokes, Fred G.----------Kelseyville

LASSEN.

Commissioner:
Taylor, A. H.----------Susanville
Deputy Commissioner:
Boggs, L. W.----------Susanville
Inspectors:
Mauer, W. R.----------Brockman
Montgomery, E. ----------Adin

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Wood, William--Hall of Records, L. A.
Deputy Commissioner:
Jones, B. R.------Hall of Records, L. A.
Inspectors:
Alderman, L. R.----950 Aliso st., L. A.
Bowles, B. R.----------San Fernando
Chidester, A. M., 446 S. Painter st., Whittier.
Dougherty, W. E.----------Azusa
Edouart, Percival E., 446 W. Santa Barbara av., Los Angeles.
Ferguson, Frank ----------Duarte
Fleury, A. C.--216 Blanche av., Tropico
Fry, I. W.----------Rivera
Gary, A. T.-------200 W. 47th st., L. A.
Helmstadter, Geo. A., 1028 E. Adams st., Los Angeles.
Hodges, J. R.----------Covina
Hyans, Jos. R.--------RFD 2, Whittier
Johns, Wm., 316 W. Colorado blvd., Eagle Rock.
Kell, D.-----161 W. 6th st., Claremont
Landon, Wm. E.----------San Dimas
Langford, E. S.-RFD, box 313, Glendora
Luxton, Wilbur F., 59 S. Wilson av., PO box 561, Station B., Pasadena.
Marleau, John B.--327 E. Pico st., L. A.
Mashmeyer, J. W.-PO box 412, Pomona
May, Louis E., 195 S. Roosevelt st., Pasadena.
Mayet, L. H., 1323 Gardner st., Hollywood.
Merlau, F. H.----636 W. 16th st., L. A.
McMullin, W. G.----------La Cañada

Montague, N. S.—122 E. 28th st., L. A.
Phillipson, W. M., 329 Linwood st., Monrovia.
Rabe, Wm. —Lancaster
Rounds, Marvin B., RFD 1, box 27, Monrovia.
Ryan, H. J.—789 Magnolia av., Pasadena
Shepherd, M.—2941 Raymond av., L. A.
Smith, A. G.—152 S. Lake av., Pasadena
Spencer, S. L.—Covina
Sweigart, M. W.—RFD 2, Whittier
Thorndike, Jos.—RFD 1, Pasadena
Turner, Bruce, 250 Cypress av., Pasadena.

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Brungus, John—Point Arena
Cotton, J. S.—Fort Bragg
Herbert, E. R.—Albion
Hughes, Nilas —Ukiah
Whitney, Frank —Willits

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Watters, Clarence—Nevada City

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Schneider, J. J.—Anaheim
Vanderlip, Edgar—Santa Ana
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Gardner, Asa —Blythe
Knight, Hugh —Elsinore
McIntyre, Wm. —Riverside
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Tuthill, E. G.—Corona
Wilson, G. R.—Corona

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Day, Leonard H.—Hollister

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Hundley, J. B.—Yucaipa
Motsinger, Charles —Cucamonga
Nelson, Charles A.—Bryn Mawr
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Hitchings, F. W.______Santa Cruz
Hopkins, H. B.______Watsonville

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Commissioner:
Lamiman, Geo. A.______Anderson

SISKIYOU.

Commissioner:
Kleaver, W. L.______Yreka
Inspector:
Callick, Richard ______Dunsmuir

SONOMA.

Commissioner:
Bremner, O. E.______Santa Rosa
Deputy Commissioner:
Galloway, A. R.______Healdsburg
Inspectors:
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Johnson, Thomas ______Glen Ellen
Shelly, W. N.______Sebastopol
Sutherland, R. L.______Santa Rosa

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Commissioner:
Rutherford, A. L.______Modesto
Inspectors:
Gray, F. C.______Newman
Steward, C. E.______Ceres
Wheeler, W. F.______Oakdale

*Corrected to March 1, 1916.

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Commissioner:
Stabler, H. P.______Yuba City

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Commissioner:
Weeks, Chas. B.______Red Bluff
Inspector:
Hoag, G. A.______Corning

TULARE.

Commissioner:
Collins, Chas. F.______Visalia
Inspectors:
Bates, W. A.______Dinuba
(Inspects shipments also at Cutler, Seville and Sultana.)
Doyle, C. H.______Porterville
(Inspects shipments also at Strathmore.)
Dungan, J. S.______Lemon Cove
Fisher, Roy ______Angiola
Klindera, F. J.______Tipton
Marr, R. W.______Pixley
Miller, H. S.______Richgrove
Mitchell, M.______Ducor
Clark, Burt ______Goshen
Newhouse, Oliver H.______Exeter
(Inspects shipments also at Farmersville.)
Roeder, J. H.______Terra Bella
Shirk, J. H.______Tulare
Smith, Earl E.______Lindsay
Webb, Steve ______Woodlake
Williams, C. H.______Springville

VENTURA.

Commissioner:
Brock, A. A.______Ventura
Inspectors:
Essig, S. H.______Ventura
French, J. N.______Oxnard
Rolls, James T.______Santa Paula
Trimble, F. M.______Moorpark
Wiklund, A. G.______Fillmore

YOLO.

Commissioner:
Hecke, Geo. H.______Woodland
Inspectors:
Bray, James ______Dunnigan
Fisk, A. ______Esparto
Gould, William ______Woodland
James, August ______Rumsey
Lamme, J. W.______Winters
Muller, Joseph ______Yolo
Parks, Oliver ______Davis
Van Tassel, Harold, PO box 199, Sacramento.

YUBA.

Commissioner:
Harney, G. W.______Marysville

THE DISTRIBUTION OF CALIFORNIA INSECTS. I.

E. O. Essig, University of California, Berkeley, California.

Under the above heading the writer desires to present from time to time a series of maps showing as accurately as possible the known distribution of some of the common economic insects of this State. In considering the subject from this viewpoint the economic insects may be placed into two large groups. In the first group might be included the native insects which are abundant throughout the State, such as the western 12-spotted cucumber beetle, *Diabrotica soror* Lec., the alfalfa semi-looper, *Phytometra californica* (Speyer), the muck or carrot beetle, *Ligyrus gibbosus* DeGeer, etc., and those introduced insects which have become widely distributed and persist in large numbers, like the black scale, *Saissetia oleæ* (Bern.), the woolly apple aphis, *Eriosoma lanigera* (Hausm.), the imported cabbage worm, *Pontia rapæ* (Linn.), the San Jose scale, *Aspidiotus perniciosus* Comst., etc. The common occurrence of such insects is so generally known that it is not thought necessary to include this group at all. In the second group might be placed the native insects which are limited in their distribution to more or less definite areas, and have become quite serious pests in those districts, like the California peach borer, *Ægeria opalescens* H. Edw., the pear thrips, *Tæniothrips pyri* (Daniel), the California oak moth, *Phryganidia californica* Pack., etc., and those introduced insects which, because of prevention, lack of time or some other reasons, are still confined to small or scattered areas, such as the citrus white fly, *Dialeurodes citri* (R. & H.), which has been persistently fought to blot out the infested districts and to prevent further spread; the purple scale, *Lepidosaphes beckii* (Newm.), which likewise has been constantly fought; the Argentine ant, *Iridomyrmex humilis* Mayr, which will probably continue to spread as rapidly in the future as in the past if let alone, etc. Much of the state and county horticultural legislation has been concerned with the members of this group and it is also this group that the writer wishes to include in this series of distribution maps. In doing this he realizes the difficulty of securing complete and exact data, and takes this opportunity to invite the most rigid criticism in the form of corrections and additions. In some cases quite large areas may be marked on the maps, when in reality the infestation consists of a number of small places, and it has been impossible to definitely ascertain all of the individual localities. In all cases the idea is to give the general infested area rather than the numerous small isolated places, so as to conform with the custom of quarantine regulations covering such situations.

The data has been compiled from many sources, including observations and printed matter from the officials of the State Commission of Horticulture, the University of California, the United States Department of Agriculture, the County Horticultural Commissioners and others, as well as the observations of the writer.

THE EUROPEAN ELM SCALE.

Gossyparia ulmi (Linnæus).

As the common name indicates, this insect is of European origin and was brought across the United States to California. It probably existed here for some years before it was discovered, inasmuch as it was found in practically all of the present known areas at nearly the same time when a search was made for it. The distribution has not changed during the past year and still remains as follows:[1] Colusa, Colusa

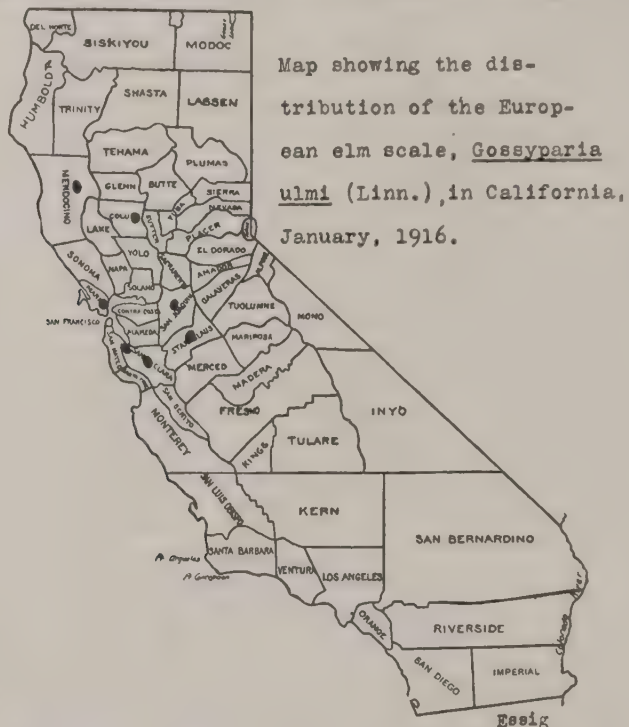

FIG. 42.—Showing the distribution of the European elm scale, *Gossyparia ulmi,* in California. (Original.)

County; Ukiah, Mendocino County; San Rafael, Marin County; Stockton, San Joaquin County; Modesto, Stanislaus County; Palo Alto, Santa Clara and San Jose, Santa Clara County.

The insect can be distributed only on branches or trees, and by carefully inspecting all new plantings of elm trees it should be possible to prevent a rapid distribution of the pest and to hold it to its present confines for many years.

THE PURPLE SCALE.

Lepidosaphes beckii (Newman).

The purple scale is one of the serious pests of citrus trees and has been consistently fought by the fruit growers and horticultural officials since its first appearance in the State in 1888 or 1889. To this strenuous effort might be credited the comparatively limited distribution of the insect. While it has quite a wide range there are large areas of citrus orchards still clean and even entire counties have succeeded in keeping it out. The present known distribution[2] is as follows:

In the city of Sacramento the insect has been present a number of years, but is confined to only a few trees, there being no commercial

[1]Essig, E. O., Inj. & Ben. Ins. Cal. 2d. edit., Cal. Hort. Com., p. 119, 1915.
[2]Quayle, H. J., Bul. 226, Cal. Agrcl. Exp. Sta., p. 321, 1912.

orchards in the vicinity of the city. This is probably the only record north of the Tehechapi, though an unconfirmed report records it in the San Joaquin Valley.[3]

In the southern part of the State the infested area is largely confined to a rather narrow strip along the coast from Santa Barbara to the

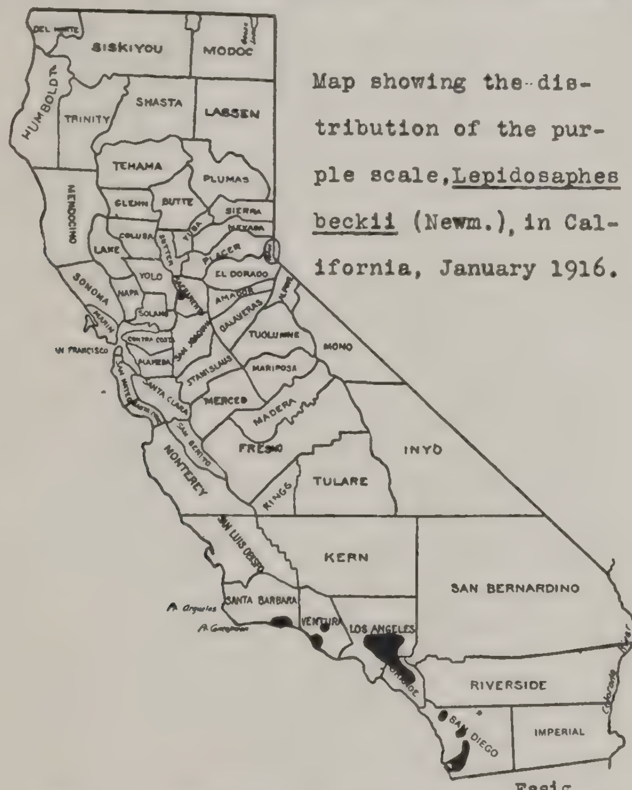

FIG. 43.—Showing the distribution of the purple scale, *Lepidosaphes beckii,* in California. (Original.)

southern extremity of San Diego Bay. In this region the chief points of infestation are given for each county.

Santa Barbara—From the city of Santa Barbara to Carpinteria.

Ventura—A small infestation at Santa Paula and another at Ventura. Both of these have been practically exterminated and every means has been taken to prevent further distribution.

Los Angeles—The infestation here occupies an area in the central part of the county and extends southward to Orange County. It may be roughly bounded by the cities of Los Angeles, Pasadena, Monrovia, Azusa, San Dimas, Covina, San Gabriel and Whittier.

Orange—The district in Orange County is also centrally located and may be indicated by the cities of Anaheim, Orange, Tustin and Santa Ana.

San Diego—In this county the scale is present in practically all of the citrus districts, including Fallbrook, Escondido, Bostonia, El Cajon, San Diego, National City, Bonita, Chula Vista and Otay.

[3] Essig, E. O., Inj. & Ben. Ins. Cal., 2d edit., Cal. Hort. Com., p. 186, 1915.

THE CITRUS WHITE FLY.

Dialeurodes citri (Riley and Howard).

The citrus white fly was undoubtedly imported into California before the quarantine against this insect was declared in 1906, and evidently became established in at least four places before that time. These places are Oroville, Marysville, Sacramento and Bakersfield.[4] A report which has not been verified also listed Visalia as once having an infested tree, but this was evidently a mistake, as repeated efforts have failed to locate it there. In 1907 the first infestation was discovered at Marysville and a campaign of extermination was begun by the State Commissioner of Horticulture, who succeeded in stamping it out at Oroville, Sacramento and Bakersfield. Other attempts were made in

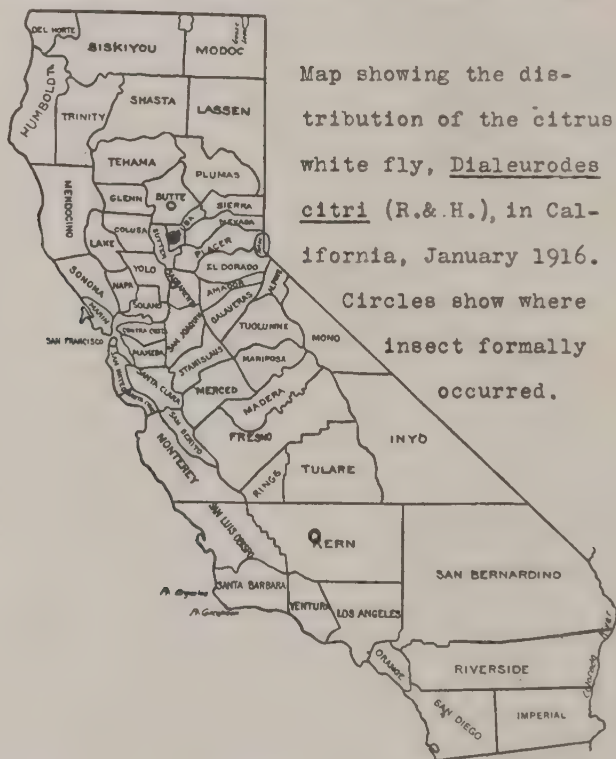

Fig. 44.—Showing the distribution of the citrus write fly, *Dialeurodes citri*, in California. (Original.)

recent years to finish the work of extermination at Marysville, but resulted only in the reduction of the infested area and failed to accomplish the desired end. However, adequate steps have been taken by the State Commissioner of Horticulture to prevent further distribution from this center.

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[4]The white fly at Bakersfield was not the citrus white fly, but another citrus infesting species, *Dialeurodes citrifolii* (Morgan), known as *Aleyrodes nubifera* Berger in Florida (Inj. & Ben. Ins. Cal., 2d edit., Cal. Hort. Com., p. 195, 1915).

THE PEAR THRIPS.

Tæniothrips pyri (Daniel).

The distribution of the pear thrips is chiefly confined to a rather small district extending from the San Francisco Bay region up the Sacramento and San Joaquin valleys for short distances. The area is well known and fairly constant and the additional discoveries have

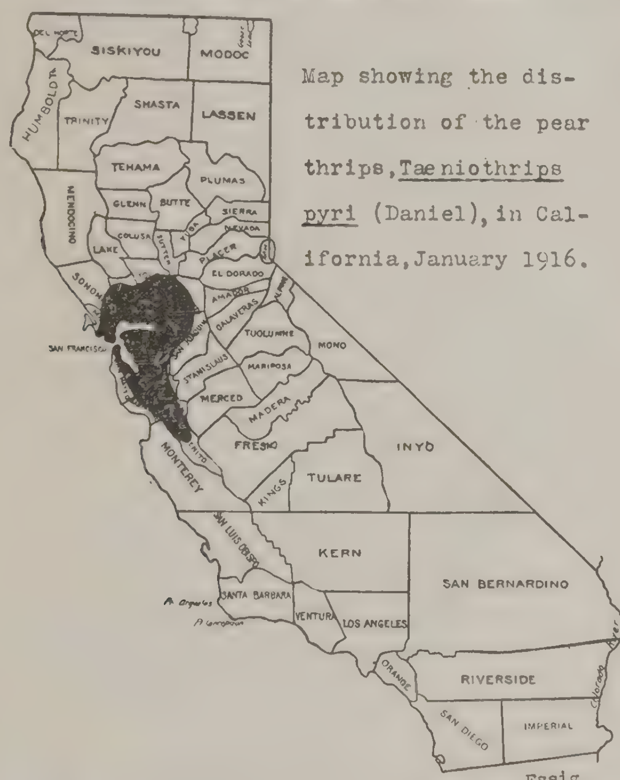


FIG. 45.—Showing the distribution of the pear thrips, *Tæniothrips pyri,* in California. (Original.)

only enlarged the boundaries. The following counties are partially or entirely included in the district: San Francisco, San Mateo, Santa Clara, Monterey, San Benito, Alameda, Contra Costa, San Joaquin, Sacramento, Yolo, Solano, Napa, Sonoma and Marin.

THE CALIFORNIA PEACH BORER.*

Ægeria opalescens (H. Edwards).

The economic significance of this insect is very interesting. Though the adults are reported to have been repeatedly taken by collectors in the Sierra Nevada mountains, the insect has become a serious pest in only a few small and well-defined areas. So far as known at the present time there are only three such areas within the State, and they are quite widely separated. In the State of Oregon there are also such infestations, with a very large stretch of country between those in

*NOTE.—A species of peach borer has also been taken from Napa County. As the insects were still in the larval stage it could not be determined at that time whether this was the California peach borer, *Ægeria opalescens,* or the eastern peach borer, *Ægeria exitiosa.*—EDITOR.

California, apparently free from any attacks. Until within a few years[5] the California peach tree borer was thought to exist only in this State and as a pest in only one district. The two recently discovered infestations show that there are possibilities of finding it elsewhere in the future. The first known and the largest infestation occurs in the region of the Santa Clara Valley and extends from Santa Clara County to Alameda, San Mateo, Santa Cruz and San Benito counties. The newer infestations were both located in the southern part of the State and are confined to small districts in two counties. The first was noted in the Upper Ojai Valley, Ventura County. Just last year County

FIG. 46.—Showing the distribution of the California peach borer, *Ægeria opalescens*, in California. (Original.)

Commissioner A. A. Brock reported another small district at Bardsdale, across the Santa Clara River from Fillmore. A small infestation at Banning and another at Beaumont, Riverside County, comprise additional infestations in the south.

The peach tree borer, *Ægeria exitiosa* Say, of the eastern states was discovered at Dehesa, San Diego County, by H. A. Weinland[6] on a few peach trees which were destroyed, and it is believed that the infestation was entirely exterminated by the drastic measures taken. Strange to say, this is the only authentic report of the occurrence of this insect in California, and is a tribute to the thoroughness of the horticultural quarantine service.

[5]Essig, E. O., Inj. & Ben. Ins. Cal. 2d edit., Cal. Hort. Com., p. 424, 1915.
[6]Essig, E. O., Inj. & Ben. Ins. Cal., 2d edit., Cal. Hort. Com., p. 421, 1915.

THE ARGENTINE ANT.

Iridomyrmex humilis (Mayr).

The Argentine ant is a newcomer which has spread rapidly throughout certain parts of the State and, unfortunate as it is, there is little hope of keeping it confined to its present distribution. It is not known just where or when the insect first gained a foothold in California, but it was first collected in the southern part in the year 1907[7]. The first definite records, however, are from the San Francisco Bay region, where the largest colonies are to be found and where the insect was probably first established.

Our present knowledge of its distribution is, of course, only fragmentary and leads us to believe that other areas are still unknown.

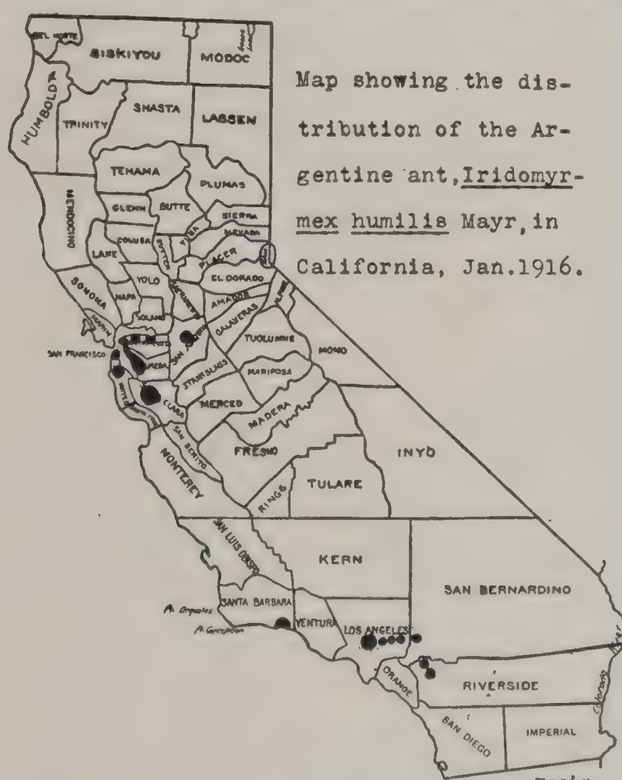


FIG. 47.—Showing the distribution of the Argentine ant, *Iridomyrmex humilis*, in California. (Original.)

This belief is based upon the fact that there have been located so many small and scattered colonies throughout the State, without attempting a thorough survey. The known records by counties are as follows:

Alameda—All of the city of Alameda is infested; the eastern half of Oakland and also all of Fruitvale, a small corner of Emeryville, one-fourth of Piedmont, one-half of Elmhurst and scattered portions of Melrose; a third of the eastern part and a few yards in the western part of Berkeley are infested. In this county the insect has become very troublesome and three cities—Oakland, Piedmont and Berkeley—have conducted "ant campaigns" to reduce the numbers.

Contra Costa—There are small colonies at Stege and Martinez and several acres infested at Byron Hot Springs.

[7]Woodworth, C. W., Circ. No. 38, Cal. Agrcl. Exp. Sta., pp. 1–2, Aug., 1908.

San Joaquin—A very large colony occupies about a third of the city of Stockton.

San Francisco—The infestation is scattered throughout the city.

San Mateo—Practically all of San Mateo and Burlingame are infested.

Santa Clara—About one-half of the territory occupied by San Jose, College Park and Santa Clara is infested. Small colonies also occur at Cupertino and Campbell.

Santa Barbara—The extent of the infestation in the city of Santa Barbara is not known. There is a small spotted infestation at Montecito.

Los Angeles—About one-third of the city of Los Angeles is infested and small colonies are to be found at Monrovia, Azusa and Claremont.

San Bernardino—Only a small colony has been located at Upland.

Riverside—Scattered colonies are to be found in the city of Riverside and in Arlington, but much of the infestation in this district occurs in the citrus orchards surrounding the city. At Corona there is a small infestation.

QUARANTINE DIVISION.

Report for the Month of January, 1916.

By Frederick Maskew.

Continued concentration of the mind on the pursuit of any particular undertaking has, beyond question, a tendency to unduly exalt the importance of the same in the opinion of those entrusted with the management and direction of its details; yet we believe that a careful analysis and digestion of the statistics which appear in this simple record of the findings of the Quarantine Division of the State Commission of Horticulture on imports of plant material during the month of January, will bring out in strong relief items of real importance, and add a measure of value to the protective purpose of the service. The pertinence of these statements and a proper sense of proportions of the value of the findings as enumerated, can easily be obtained by comparing the same with the sums of money which the present congress is being asked to appropriate for further attempts to control insect pests and plant diseases that have gained an entrance and are ravaging the crops in other states of the United States, and which so far have been kept from entering and becoming established in the State of California.

SAN FRANCISCO STATION.

Steamship and baggage inspection—

Ships inspected	64
Passengers arriving from fruit fly ports	2,247

Horticultural imports—

	Parcels.
Passed as free from pests	155,195
Fumigated	1,949
Refused admittance	185
Contraband destroyed	24
Total parcels horticultural imports for the month	157,353

Pests Intercepted.

From China (Hongkong)—

Fungus on pomeloes.

From Cuba—

Howardia biclavis on gardenia.

From Florida—

Phomopsis citri on grapefruit.

From Hawaii—

Pseudococcus bormeliæ and *Diaspis bromeliæ* on pineapples.
Coccus longulus on betel leaves.
Chrysomphalus aonidum and *Hemichionaspis minor* on palm.

From Holland—

Lepidosaphes ulmi on boxwood.
Phytomyza aquifolii on hollies.

From Iowa—

Eriosoma lanigera on crabapple.
Larvæ of peach-root borer in almonds.

From Italy—

Aspidiotus hederæ on olive trees.

From Japan—

Psyllid on aralia.
Fungus on wistaria.
Cicada eggs on wistaria and persimmon.
Larvæ of weevil in sweet potatoes.
Larvæ of weevil in chestnuts.
Fungus on pomeloes.
Fungus on oranges.
Hemichionaspis aspidistræ on aspidistra.
Hemichionaspis minor on *Dracena* sp.

From Manila—

Lepidopterous larvæ in beans (in pod).

From Mexico—

Lepidosaphes gloverii on limes.

From Tahiti—

Lepidosaphes beckii on limes.

LOS ANGELES STATION.

Ships inspected ---------- 34

Horticultural imports—

	Parcels.
Passed as free from pests	80,604½
Fumigated	12
Refused admittance	3
Contraband destroyed	5½
Total parcels horticultural imports for the month	80,625

Pests Intercepted.

From Central America—

Aspidiotus cyanophylli, *Aspidiotus cydoniæ*, *Pseudococcus* sp., and *Saissetia hemisphærica* on bananas.

From Florida—

Phomopsis citri on grapefruit.
Lepidosaphes beckii and *Parlatoria pergandii* on oranges.

From Idaho—

Rhizoctonia on potatoes.

From Japan—

Agromyza websteri on wistaria.
Pseudaonidia pæoniæ on azaleas.
Pseudaonidia pæoniæ and *Lepidosaphes lasianthi* on camellia.
Mantis and Cicada eggs on persimmon.
Hemichionaspis aspidistræ on *Aspidistra lurida.*
Lepidosaphes newsteadii on umbrella pines.

From Mexico—

Chionaspis sp. on cocoanuts.

From Oregon—

Rhizoctonia on potatoes.
Phylloxera vastatrix on grapevines.

From Texas—

Parlatoria pergandii on grapefruit.

From Virginia—

Pseudococcus sp. on rose plants.

SAN DIEGO STATION.

Steamship and baggage inspection—

Ships inspected	28
Fish boats inspected	32
Passengers arriving from fruit fly ports	106

Horticultural imports—

	Parcels.
Passed as free from pests	5,755
Fumigated	20
Refused admittance	5
Contraband destroyed	5
Total parcels horticultural imports for the month	5,785

Pests Intercepted.

From Belgium—

Aspidiotus brittanicus and *Coccus hesperidum* on bay trees.

From Mexico—

Lepidosaphes beckii on limes and cocoanuts.
Chrysomphalus sp. on cocoanuts.

From Oregon—

Root knot on grape and plum stock.
Crown gall on peach, apricot, plum and rose stock.
Woolly aphis on Bartlett and Winter Nelis pear stock.

EUREKA STATION.

Steamship and baggage inspection—

Ships inspected	6

Horticultural imports—

	Parcels.
Passed as free from pests	315
Destroyed	6
Total parcels horticultural imports for the month	321

Pests Intercepted.

From Holland—

Phytomyza aquifolii and *Lecanium* sp. on hollies.

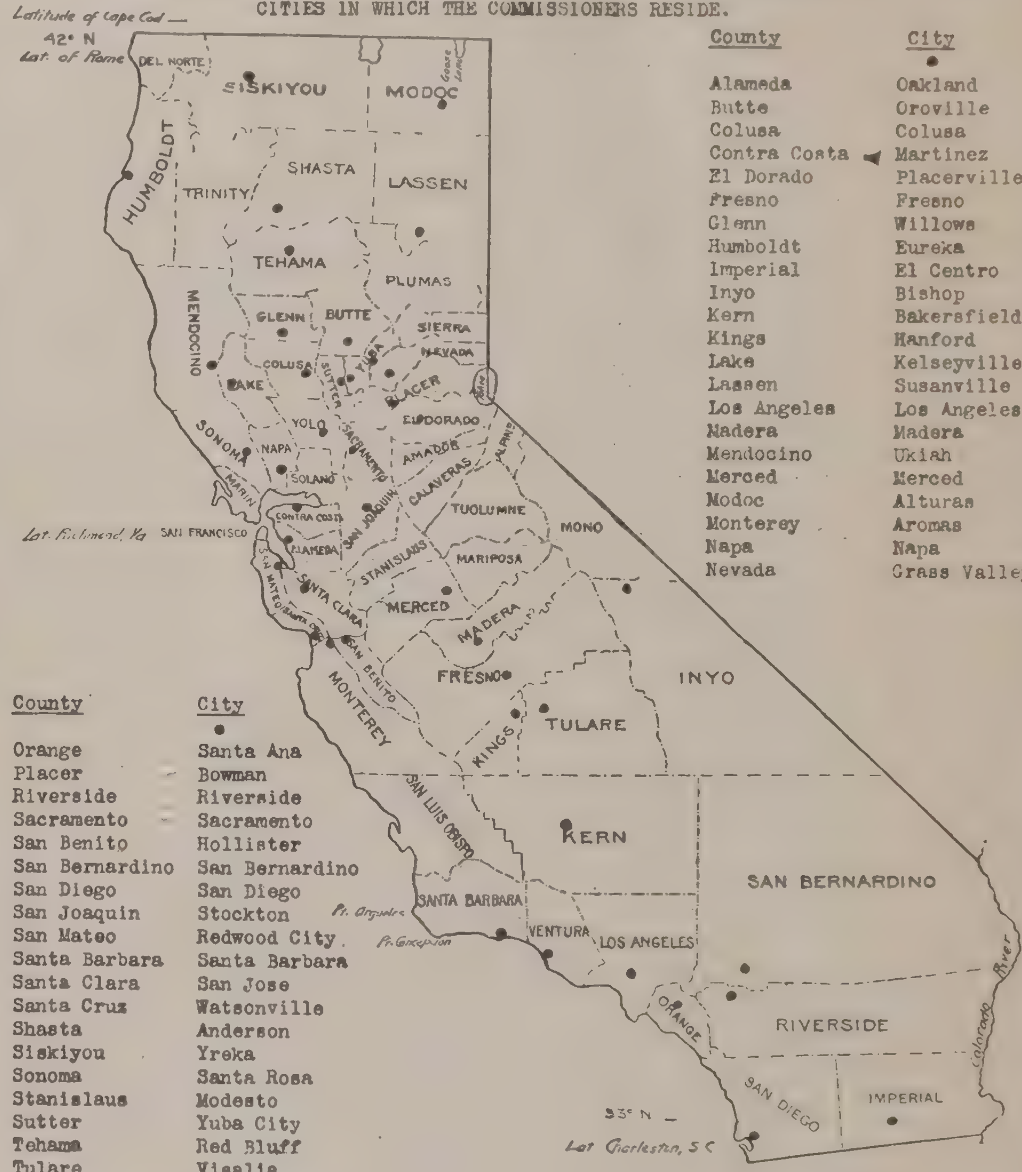
From Japan—

Egg masses of *Porthetria dispar* on cedars.
Thyridopteryx sp. on azaleas.
Lepidopterous larvæ on Thuya.
Mantis eggs on azalea and Thuya.

SANTA BARBARA STATION.

(No report.)

COUNTIES HAVING HORTICULTURAL COMMISSIONERS, WITH THE RESPECTIVE CITIES IN WHICH THE COMMISSIONERS RESIDE.



County	City
Alameda	Oakland
Butte	Oroville
Colusa	Colusa
Contra Costa	Martinez
El Dorado	Placerville
Fresno	Fresno
Glenn	Willows
Humboldt	Eureka
Imperial	El Centro
Inyo	Bishop
Kern	Bakersfield
Kings	Hanford
Lake	Kelseyville
Lassen	Susanville
Los Angeles	Los Angeles
Madera	Madera
Mendocino	Ukiah
Merced	Merced
Modoc	Alturas
Monterey	Aromas
Napa	Napa
Nevada	Grass Valley

County	City
Orange	Santa Ana
Placer	Bowman
Riverside	Riverside
Sacramento	Sacramento
San Benito	Hollister
San Bernardino	San Bernardino
San Diego	San Diego
San Joaquin	Stockton
San Mateo	Redwood City
Santa Barbara	Santa Barbara
Santa Clara	San Jose
Santa Cruz	Watsonville
Shasta	Anderson
Siskiyou	Yreka
Sonoma	Santa Rosa
Stanislaus	Modesto
Sutter	Yuba City
Tehama	Red Bluff
Tulare	Visalia
Ventura	Ventura
Yolo	Woodland
Yuba	Marysville

THE MONTHLY BULLETIN.

CALIFORNIA STATE COMMISSION OF HORTICULTURE

Vol. V. April, 1916. No. 4

THE ACT RELATING TO THE STANDARDIZATION OF FRUIT PACKING.

By Geo. P. Weldon.

The necessity for standardization of fruit packing received timely recognition by the last legislature, and at the hands of the Governor, who signed two bills which went into effect on August 9, 1915, viz, the Apple Standardization Act and the Fruit Standardization Act. The former was given a thorough trial at Watsonville last season and proved to be a worthy measure, as it brought a premium of at least 10 cents per box to those who packed according to its provisions. The latter act went into effect after apricots, peaches, cherries, plums and a large part of the pears and berries were packed, consequently its value in the case of these fruits was not tested. In the case of grapes results were highly gratifying, and the table grape growers can testify to its efficiency because of an increase in prices beyond all expectations, and the best season that these growers have experienced for some time.

Because of the fact that all fruits included in this act will be packed as specified, during the coming season, the law in full is being printed herewith, so that as many fruit growers as possible may become familiar with its provisions.

The enforcement of the fruit standardization law is in the hands of the county horticultural commissioners in counties where these officials are hired, and fruit inspectors are appointed by the supervisors upon petition of twenty-five bona fide resident fruit growers in counties having no horticultural commissioner. As the purpose of the law is to benefit the growers directly, there should be little trouble in its enforcement, and the horticultural commissioners and inspectors should have the united support of every one interested in the permanent betterment of the fruit industry.

The absolute impossibility of inspectors examining every packed box of fruit is apparent to all, and no matter how conscientious and capable these officials may be, the greatest good can be accomplished only when the fruit growers, packers and shippers themselves are in sympathy with the work and are willing to co-operate with the inspectors in making their packages of fruit conform to the specifications. It was this co-operation of growers, packers and shippers with county horticultural commissioners in San Joaquin, Fresno, Sacramento and other counties growing table grapes, that made efficiency possible last season in the case of standardized packing of grapes, which resulted in splendid prices.

It is of interest to note that in San Joaquin County the late Horticultural Commissioner, William Garden, with the aid of two field inspectors, was able to look after the work in the entire county. The closest co-operation was secured through a series of meetings held in various parts of the county, previous to the packing season. The law was printed in several languages, so that even the foreign element had little excuse for not knowing of its provisions. As a consequence of this preliminary work no trouble whatever was experienced in the enforcement of the law.

STANDARDIZATION OF FRUIT PACKING.

An act to establish a standard for the packing in the State of California of the kinds of fresh fruits specified in this act, for sale or for transportation for sale, for interstate and foreign shipment, and to prevent deception in the packing; also to establish a system of inspection for the same.

Chapter 659, A. B. 851, 1915.

[Approved June 10, 1915. In effect August 9, 1915.]

The people of the State of California do enact as follows:

SECTION 1. There is hereby created and established a standard for the packing of fresh fruits, for interstate and foreign shipment, of the kinds specified in this act.

SEC. 2. Any box, basket, package or container of fresh fruit of the kinds specified in this act, which shall be packed and offered for sale or for transportation for sale, shall be packed in accordance with the specifications herein made.

SEC. 3. All deciduous fruits of the kinds specified in this act when packed shall be practically free from insects and fungous diseases.

SEC. 4. All fresh fruit of the kind specified in this act which shall be sold in bulk or loose in the box without packing, shall be exempt from the provisions of this act.

SEC. 5. All cherries packed in boxes or packages shall contain fruit of practically uniform quality and maturity and one variety only, excepting that such boxes or packages may contain more than one variety if such fact be plainly stamped on the outside of the box or package with the words "Mixed Varieties" with letters one-half inch high. Each box or package shall be stamped on the outside with the minimum weight of contents, and name of variety or varieties.

SEC. 6. Peaches, apricots, pears, plums and prunes, shall be of practically uniform size, quality and maturity. When packed in crates, packages or containers made up of two or more sub-containers having sloping sides, for the purpose of ventilation of the fruit therein, the fruit shall not vary in size more than ten per cent and no layer below the top layer shall contain a greater numerical count than the top layer. Each box, crate, package, container or sub-container shall be stamped upon the outside with the minimum weight of its contents. Each box, crate, package or container, except sub-containers, shall bear in plain letters the name of the variety contained therein. When packed in a box,

package or container having perpendicular sides and ends, each box shall contain approximately the same numerical count in each layer; *provided*, that when peaches are packed in boxes, packages or containers, having perpendicular sides, the box, package or container shall also be marked upon the outside of the end thereof in plain figures with the approximate number of peaches in the box, which shall be within four peaches of the true count.

Sec. 7. Grapes packed for table use shall be of uniform quality and maturity and shall be well matured and show a sugar content of not less than seventeen per cent Balling's scale, except Emperor, which shall show not less than sixteen per cent Balling's scale. Each crate or other package and containers therein shall bear in plain figures the minimum weight of contents. Each crate or package except sub-containers shall be stamped in plain letters with the name of the variety.

Sec. 8. Berries shall be packed in uniform packages of dry quart containing an interior capacity of 67.2 cubic inches, or dry pint containing an interior capacity of 33.6 cubic inches and shall be reasonably uniform in size, quality and maturity throughout the package or container.

Sec. 9. Cantaloupes shall be placed in standard crates 12 x 12 x 23½ inches containing forty-five cantaloupes of uniform size and maturity. Pony crates 11 x 11 x 23½ inches containing forty-five cantaloupes of uniform size and maturity. Jumbo crates 4½ x 13½ x 23½ inches containing twelve cantaloupes of uniform size and maturity or containing fifteen cantaloupes of uniform size and maturity.

Sec. 10. All boxes, crates, packages or containers of deciduous fruits of the kinds specified in this act, except sub-containers, when packed and offered for sale, or for transportation for sale, shall bear upon them in plain sight, and plain letters on the outside the name of the orchard, if any, and the name and post office address of the person, firm, company, corporation or organization, who shall have first packed or authorized the packing of the same, also the name of the locality where the fruit is grown.

Sec. 11. In counties having a county horticultural commissioner it shall be his duty (and the duty of his deputies) acting as inspectors, which office is hereby created, to enforce the provisions of this act. Additional inspectors shall be appointed by the county horticultural commissioner, upon petition of like nature and at the same pay as provided in section twelve of this act; *provided*, that any county having and enforcing a standard higher than the standard in this act shall be exempt from the provisions of this act upon declaration to such effect by the state horticultural commissioner.

Sec. 12. In a city and county or in counties having no county horticultural commissioner, or deputy, it shall be the duty of the county board of supervisors, upon petition filed with them to appoint inspectors. Said petition shall be signed by at least twenty-five bona fide fruit growers residing in that county, or city and county. The inspectors shall receive for their services the sum of three and one half dollars per day to be paid monthly

upon warrants drawn upon the county treasurer. Upon the petition of twenty-five resident freeholders who are fruit growers or shippers of fruit, the county horticultural commissioner, or board of supervisors, where there is no county horticultural commission, shall immediately remove said inspector for neglect of duty, malfeasance in office, or general unfitness for office. In case of such removal the office shall immediately be filled.

SEC. 13. Any person, firm, company, corporation, or organization, who shall knowingly pack, or cause to be packed, fruit of the kinds specified herein, in boxes, crates, packages, containers, or sub-containers, to be offered for sale or for transportation for sale, in wilful violation of this act, shall be guilty of a misdemeanor.

SEC. 14. All laws in conflict with this act or any part thereof are hereby repealed.

SEC. 15. If any section, sub-section, sentence, clause or phrase of this act is for any reason held to be unconstitutional such decision shall not affect the validity of the remaining portions of this act. The legislature hereby declares that it would have passed this act, and each section, sub-section, sentence, clause and phrase thereof, irrespective of the fact that any one or more other sections, sub-sections, sentences, clauses or phrases be declared unconstitutional.

THE MUTUAL INDEBTEDNESS OF SCIENCE AND AGRICULTURE.

By JOHN M. COULTER, Professor of Botany, University of Chicago.

The subject suggested to me was "Agriculture's Debt to Science"; but this seems one-sided, for science is also indebted to agriculture. Therefore, I wish to consider briefly how these two great fields of work are indebted to one another.

It would be presumptuous for a mere botanist to address a group of experts in agriculture (using the large application of that term as meaning the practical handling of plants) upon what botany, as a science, has done for agriculture, especially as my own special field of research seems to be about as far removed from any possible practical application as can be imagined.

Men who spend their lives in universities, especially the older ones, are apt to develop certain unfortunate peculiarities. These peculiarities may not make them less happy, or less useful to their professional students, but they diminish the appreciation of the community at large. In the life of such an instructor or investigator there is a peculiar kind of isolation that is bound to react. It is partly the isolation of a subject which seems more or less separate from general human interests, at least in the aspects he is cultivating. It is also an isolation of authority, which comes from the mastery of a subject and association with students who recognize this mastery. To speak with authority in intellectual matters, to give the deciding word, to meet a constant succession of inferiors, is apt to affect any man's outlook on the world of

practical affairs. Either he becomes dogmatic in expression, or he must hold himself in check with an effort.

There is much honest effort to break down this barrier between the scholars who represent universities and the great host of men who represent the community. These men are not so isolated, but they are just as dogmatic in their own way, and they are immensely influential.

Here are two groups of men, the scientific and the practical, both powerfully equipped, who should be mutually stimulating in all that makes for progress.

Men engaged in research are looked upon in general as inoffensive but curious and useless members of the social order. If an investigator touches now and then upon something that the public regards as useful, he is singled out as a glaring exception. If an investigation lends itself to announcement in exceedingly sensational form, as if it were uncovering deep mysteries, the investigator becomes a marked man, and his lightest utterance is treated as an oracle. The fact is that the great body of investigators who are doing the substantial work that makes for scientific and practical progress are unknown to the public.

There is a conventional application of the term science which I wish to use for convenience. Thus applied, there has arisen a classification of science into two phases, called *pure* science and *applied* science. An attempt to define these two kinds of science reveals the fact that the distinction is a general impression rather than a clear statement. If the impression be analyzed, it seems that pure science is of no material service to mankind; and that applied science has to do with the mechanism of our civilization. The distinction, therefore, is based upon material output. In other words, pure science only *knows* things, while applied science knows how to *do* things. This impression has been unfortunate in several ways. The public, as represented by the modern American community, believes in *doing* things; and therefore to them pure science seems useless, and its devotees appear as ornamental, rather than as vital members of human society, to be admired rather than used. On the other hand, the universities, as represented by their investigators, believe in *knowing* things; and therefore to them applied science seems to be a waste of investigative energy, and its devotees appear to be very unscientific.

In this atmosphere of mutual misunderstanding, the public and the investigators have continued to exist and make progress, all the time acknowledging their interdependence by mutual service. In recent years, however, the spirit of mutual service has become more dominant; and investigators are beginning to recognize their greatest mission in contributing assistance in solving the problems that confront community life.

I wish to indicate the real relation that exists between what has been called pure science and applied science. As an introductory illustration, there may be outlined the usual steps that botanical science has taken in the material service of agriculture. An investigator, stimulated only by what has been called "the delirious but divine desire to know," is attracted by a problem. No thought of its usefulness in a material way is in his mind; he wishes simply to make a contribution to knowledge. The investigator succeeds in solving his problem, and is satisfied. Later—perhaps many years later—some other scientific

man discovers that the results of the former investigation may be used to revolutionize some empirical formula of agriculture. The application is made and the world applauds; but the applause is chiefly for the second man, the practical man. Any analysis of the situation, however, shows that to the practical result both men were of great material service. The ratio that exists between these two types of scientific men is unknown, but the first is much the more rare.

Another illustration is needed as a corollary. In this case an investigator, stimulated by the desire to serve the community, is attracted by a problem. He succeeds in solving his problem, perhaps makes his own application, and is satisfied. Later, some other scientific man discovers that the results of the former may be used to revolutionize certain fundamental conceptions of science. His statement is made and the scientific world applauds; and this time the applause is chiefly for the second man, the pure scientist. The analysis of this case shows, however, that to the scientific result both men contributed, and that both men were of large scientific service.

A third illustration is needed to complete the real historical picture of progress in scientific knowledge and its practical applications to agriculture. A practical man, not trained as an investigator, faces the problem of obtaining some new and useful result with plants. His only method is to apply empirically certain formulæ that have been developed by science, but with ingenuity and patience he succeeds, although he is not able to analyze his results. And yet, his procedure reveals to a trained investigator a method or certain data that lead to a scientific synthesis of the first order.

These illustrations represent the actual historical situation of the mutual influence of botany as a science and agriculture. Now what are the conclusions?

It is evident that responsibility for the practical results of the science of botany to agriculture is to be shared by those engaged in pure science, those engaged in applied science, and those not trained in science at all. The only distinction is not in the result, therefore, but in the intent. In other words, the difference between pure science and applied science, in their practical aspects, resolves itself into the difference between murder and manslaughter; it lies in the intention. So long as the world gets the results of science, it is not likely to trouble itself about the intention.

Another conclusion is that all application must have something to apply, and that application alone would presently result in sterility. There must be perennial contributions to knowledge, with or without immediately useful intent, that application may possess a wide and fertile field for cultivation.

A final conclusion may be that all science is one; that pure science is often immensely practical; that applied science is often very pure science; and that between the two there is no dividing line.

I wish to illustrate these general statements concerning pure science and applied science, represented in our interests by botany and agriculture, by some more specific statements concerning their mutual interests.

The science of botany has had a remarkable history. Beginning with the investigation of plants for what were called their medicinal virtues, it developed with various progressions and retrogressions, until the

botanist came to be regarded as about the most useless intelligent member of society. His chief concern seemed to remove him so far from the general human interest that he was regarded as a harmless crank, at best a man of only ephemeral interest. No such opinion could have developed unless there had been some basis for it. The most unfortunate result of this public estimation of botany was that it lingered much longer than it was deserved; and consequently, when the other so-called sciences had won public esteem, either through their services or their appeal to the wonder-instinct, botany lagged behind in public recognition, and in most educational institutions was the latest born into the family of sciences. But, finally, it also began to render signal service and the appeal to the wonder-instinct.

This is not the occasion for me to give an account of the wonderful recent development of several phases of botanical activity, phases which deal with the fundamentals of plant activity of all kinds. Among them, however, there is no one attracting more attention at this time, both in its scientific and in its practical aspects, than plant-breeding. It is not my purpose to recite the notable achievements that are to be grouped under this title, for they are familiar to all who are interested in the handling of plants, either for practical or scientific reasons. Especially is it unnecessary to give the details to this audience, representing as it does an experience in the results of plant-breeding that is probably more extensive and varied than in any region of our country. But in passing, allow me to say that plant-breeding in its practical possibilities is in its infancy; and that the immediate future has in store for us achievements which we did not dream of until scientific plant-breeding made them possible. Without going into details, therefore, I simply wish to use plant-breeding as an illustration of my general thesis.

The practical aspect of plant-breeding, in a certain sense, is as old as the culture of plants. Long experience in the practical handling of plants slowly developed a kind of knowledge that became formulated in empirical practice; that is, practice whose meaning was not understood, but whose result experience assured. The general purpose was to improve old forms and to develop new ones. The improvements were numerous, and apparently were possible in any direction determined by the need or taste of man. It was learned that improvements must be kept improved; in other words, that they would not remain constant if left freely to nature. This was a laborious but profitable method of plant-breeding, the method known in general as mass culture or mass selection. The most desirable individuals were selected and guarded through a series of generations, until the desired character was built up sufficiently for commercial purposes. This is the oldest and still the most widely used method of practical plant-breeding, begun by unconscious selection and merging into intelligent selection.

During all this period of plant improvement by mass culture and continuous selection, the so-called science of botany was cultivating a singularly distant field. In short, botany was not practical, and plant-breeding was not scientific. Therefore, botanists on the one hand, and agriculturists, horticulturists, floriculturists, etc., on the other hand, were as distinct from one another as if they had nothing in common. It

so happened that botanists were dealing with very superficial problems in a scientific way, and that plant-breeders were dealing with the most fundamental problems in an empirical way.

As in any other practice, plant-breeding developed now and then an unusually successful practitioner, who made distinct contributions in the form of important results; but this represented no more of an advance than does the fact that one cook can surpass another cook in the art of making bread. This caution is necessary, for the results obtained empirically by skillful plant-breeders are too often ascribed to unusual scientific insight. The result is important enough, without reading into it what it does not contain.

What may be called the second period of plant-breeding was ushered in when organic evolution began to be put upon an experimental basis. Plant-breeding had been practical, but with no scientific basis; now a new plant-breeding was established, which was scientific, and with no practical motive. The new motive was the accumulation of data bearing upon the problems of inheritance and the origin of species.

The third phase of plant-breeding can hardly be called a third period. for it is practically synchronous with the second. As a by-product of the work on inheritance and evolution, some of the scientific results have been applied to practical plant-breeding, and the result has been an expansion of its possibilities that may well be called marvellous. In short, practical plant-breeding is now on a scientific basis; and botany has at last attacked the fundamental problems and may be of some practical service, for it includes plant-breeding.

Perhaps it may not be out of place to remind you of the large importance of this combination, for it underlies the welfare of human society. It is a combination of scientific research and its practical application in maintaining an ever-increasing food supply over ever-extending areas. If it is the function of medical research and its application to provide for the welfare of a certain per cent of the population, it is one of the functions of botanical research and its application to agriculture to provide for the welfare of the *whole* population. Nor is scientific plant-breeding, in its restricted definition, the sole contributor to this end, but bound up with it are plant physiology, ecology, pathology, soil investigations, and the whole round of interests that touch living plants. In short, there is now possible, for the first time, such a co-operation of scientific results towards a definite end as to make rapid progress possible. For example, it is now possible to secure

(1) Races of maximum yield for every area, so that the yield of this country shall not be an average between minimum and maximum, but maximum everywhere.

(2) Drought-resistant races, so that crops not only can be insured against drought where they are now grown, but also can be enormously extended in area.

(3) Disease-resistant races, so that cultivated plants shall be immune and the loss from diseases eliminated.

When these possibilities are realized, food production can easily keep pace with increasing population; at present it is lagging far behind.

In presenting this fleeting glimpse of the problems and accomplishments of plant-breeding, I have intended to emphasize not only its fundamental importance to both botanical science and agricultural practice, but also the inextricable entanglement of the two. Any result

of scientific plant-breeding, representing as it must additional knowledge of the processes of evolution and heredity, may become of practical service; and any result of practical plant-breeding, involving as it does extensive experiments with plants, may prove to be of great scientific importance. They are mutually stimulating, and both are necessary to the most rapid development of knowledge.

It is the proper balance between the two that must be maintained. The physical needs of man, great as they may be, must never obscure the intellectual needs of man; especially as the trained intellect is the speediest agent in meeting physical need. On the other hand, the intellectual needs of man, noble as they may be, must never lose sight of the fact that the speediest results are obtained by the enormous increase of experimental work under the pressure of physical necessity.

The motto of botany and of agriculture, therefore, is the same: A practice based on science, and a science that extends and illuminates practice.

HERBICIDE INVESTIGATIONS.

By Geo. P. Gray, Insecticide Laboratory, University of California, Berkeley, Cal.

The State Agricultural Experiment Station is conducting an investigation to determine the most suitable chemical for use in the destruction of weeds. Tests are being made of the various chemicals which have been suggested for this purpose and some new compounds are being tried out. Analyses are also being made of the commercial preparations which are sold as weed destroyers.

The proper strength of the chemical to be used, the time of year to obtain the best results, and the effect on the soil are all questions of great importance and are under investigation. These questions should be answered by conducting carefully planned experiments before the general use of any chemical as an herbicide should be either condemned or recommended.

Recommendations for the use of arsenic in destroying weeds are so frequently made in the papers, and proprietary weed killers are being so widely advertised that it seems a word of warning should be issued against their indiscriminate use. In many instances weed destroyers of unknown composition and home-made preparations of arsenic and other chemicals are carelessly handled with little thought of the danger of poisoning persons and animals, and of possible ill effects on the soil if used too liberally.

DANGER IN USING ARSENIC FOR DESTRUCTION OF WEEDS.

The arsenical herbicides are usually made by dissolving commercial white arsenic (arsenic trioxide) in caustic soda, or sal soda, and water. When dissolved in this manner, a corrosive chemical is formed, known as sodium arsenite, which is even more poisonous than the original white arsenic. This is not only poisonous to the higher animals and insects, but also acts as a violent poison to practically all plant life.

Harmless Appearance: When pure sodium arsenite is dissolved in water, it makes a colorless and oderless solution, having only a

slight taste. This harmless appearance greatly adds to the danger of accidental poisoning.

Danger to Live Stock: Forage plants, when sprayed with arsenicals, seem to be especially attractive to live stock. Cattle, horses and even poultry have been poisoned by eating Johnson grass which had been sprayed with an arsenical weed killer. Areas which are to be treated with a poisonous herbicide should, therefore, be carefully fenced to avoid the possible loss of valuable live stock.

Arsenic Carried by Smoke: When a rank growth of vegetation has been destroyed with a heavy arsenical application, considerable caution must be used if it is desired to burn the brush. The arsenic would be very readily volatilized in this manner and would be carried in the smoke. Persons should, therefore, be extremely cautious about inhaling the smoke, for it is thought that a poisonous dose of arsenic could be easily inhaled in this way.

Poisonous to Crops: The action of sodium arsenite is more severe on broad-leafed plants than on grasses, although a violent poison to practically all plants. In using it for the destruction of weeds, it is, therefore, usually necessary to avoid getting it on trees and cultivated crops.

Effect on the Soil: The Experiment Station is observing the effect of arsenic and other chemicals upon the soil. It has been found elsewhere that arsenic is accumulated in the top layer of the soil and is not easily washed out by rains, so that it should be rather sparingly used on this account.

Notwithstanding its poisonous nature, however, it may be proven that arsenic will be a valuable aid to the farmers of the State in the control of some of the most troublesome weeds, if used with discretion.

UNQUALIFIED ENDORSEMENT OF ARSENIC NOT GIVEN.

The writer has received many requests for a formula for the preparation of soluble arsenic for use in weed control. He has usually hesitated to give a formula, thinking that by so doing an endorsement of the general use of arsenic as a weed killer might be implied. The experiments have now been conducted for a sufficient length of time, however, to justify the recommendation of formulas for the benefit of those who wish to conduct independent experiments on weed control.

The uncompleted state of the experiments now in progress does not warrant recommendations for their use except in an experimental way, and in the preparation of a spray to prevent the maturing of seeds as indicated in statement "6" at the close of the article. The writer does not assume any responsibility for their use other than noted above.

SOURCE OF ARSENIC.

The raw material used for the preparation of all compounds of arsenic is the white arsenic of commerce, chemically known as arsenic trioxide. This substance is recovered as a by-product from the smoke of some of the smelters of the western states. According to the United States Geological Survey, some three thousand tons are annually produced in this country and a much larger amount is imported under normal conditions.

SOLVENTS FOR ARSENIC.

White arsenic is not very soluble in water, although sufficiently so to prohibit its use on plants as an insecticide. In order to make a strong solution of arsenic, it is customary to dissolve white arsenic in water with either sal soda, soda ash, caustic soda, or concentrated lye. Similar potash or ammonia compounds could also be used, but they are more expensive and would be no better than the soda compounds, except for special purposes.

The following table may be of use in indicating the approximate weights of the commoner solvents required for the solution of white arsenic (arsenic trioxide):

Solvent	Solvent parts by weight	Arsenic trioxide parts by weight
Sal soda or washing soda ($Na_2CO_3.10H_2O$) (crystallized sodium carbonate)	2 to	1
Soda ash (Na_2CO_3 and impurities) (crude sodium carbonate)	1 to	1
Caustic soda (NaOH) (sodium hydroxide)	1 to	2*
Concentrated lye (mixture of NaOH and Na_2CO_3) (may also contain similar potash compounds)	1 to	2

If sal soda or soda ash is used, it is necessary to boil the mixture to dissolve the arsenic. If caustic soda is used, little or no boiling is required. In either case, however, a corrosive chemical is formed, known as sodium arsenite (or arsenite of soda), which is readily soluble in water and is even more poisonous than the original white arsenic.

COMMERCIAL SODIUM ARSENITE.

Sodium arsenite may be purchased ready made as a white powder. The chemistry of arsenites is rather complex, and there are many recognized forms of sodium arsenite, among which may be mentioned by way of illustration, the ortho, meta, and pyro, and both neutral and acid types, each one normally containing a different percentage of arsenic. The commercial article frequently has a large excess of sodium carbonate and other impurities. So far as known, the poisonous quality of a soluble arsenite is dependent solely upon the amount of arsenic which it contains, the soda, potash, or ammonia serving only as a solvent for the arsenic. Quite variable results are, therefore, to be expected from the use of commercial sodium arsenite. It can not be recommended as a dependable material on account of the great variation in the percentage of arsenic as found by analyses made in the insecticide and fungicide laboratory. It appears, however, that the purity of the white arsenic of commerce can be depended upon. Many samples have been analyzed and in no case was a sample found to be much less than 99 per cent pure. It is recommended, therefore, that the soluble arsenicals be made up with white arsenic whose purity may be depended upon with reasonable certainty, or that sodium arsenite be purchased from a reliable firm with a definite guarantee of the amount of arsenic which it contains.

*A soluble arsenical can also be made by using one part of caustic soda to four parts of arsenic trioxide.

DISSOLVING ARSENIC.

The handling of arsenic and corrosive substances by one unfamiliar with the behavior of chemicals and the bringing of poisons into the kitchen are practices to be avoided if possible. The preparation of small quantities of poison is troublesome and the saving usually does not warrant giving the necessary time and attention. It would be preferable to buy the poison ready to use, provided the price is reasonable and a true statement of its composition is made by the dealer. The use of secret preparations is discouraged for the reasons given in Circular 141 of the California Agricultural Experiment Station. Under certain conditions it may be desirable to prepare small quantities of sodium arsenite on the kitchen stove. The preparation of larger amounts presents no great difficulties or dangers, if adequate facilities are available out of doors and the operator is at all familiar with the handling of chemicals. Extra precautions, however, should be observed at all times in the manipulation of arsenic.

Sal soda (also known as washing soda or crystallized sodium carbonate) is preferable for dissolving small quantities in the kitchen. It can be obtained at any pharmacy or grocery store and is not nearly so caustic as caustic soda or concentrated lye.

FORMULA 1.

Sal soda	2 ounces
White arsenic	1 ounce
Water (one cup), about	8 ounces

Put all the ingredients together in an iron or granite-ware kettle (do not use aluminum) of at least one quart capacity and boil until clear. Considerable foam is produced by this combination, and the kettle is apt to boil over unless a large one is used, particularly if the kettle is not perfectly clean. Should any of the liquid be spilled upon the stove, the fumes should not be inhaled. Do not inhale any of the steam, as some of the arsenic may be carried over mechanically in the vapor.

For the preparation of larger quantities in the same manner, the formula should read:

FORMULA 2.

Sal soda	2 pounds
White arsenic	1 pound
Water	1 gallon

Soda ash may be substituted for sal soda in the above formulas. This chemical costs about one third more than sal soda, but *only one-half as much* is required, so that its use would be somewhat more economical.

SUGGESTED FORMULA.

Caustic soda (*sodium hydroxide*) or a good grade of concentrated lye is much more active in dissolving arsenic than either sal soda or soda ash and much less is required, although the cost is greater per pound. Very little heat is required in the preparation of sodium arsenite by means of these materials. If made in large quantities, the

use of heat is unnecessary. The preparation of a very concentrated stock solution is a very simple matter if caustic soda is used. The chief advantages in its use as a solvent are as given above. The chief objection to its use is on account of its causticity. Great care must be exercised in its handling, as its action on the skin is very severe. A spray made up with an excess of caustic soda is more disagreeable to use than one made up with an excess of either soda ash or sal soda.

A convenient stock solution of sodium arsenite may be made up in accordance with the following formula:

FORMULA 3.

Granulated caustic soda (98 per cent)	10 pounds
White arsenic (arsenic trioxide 99 per cent)	20 pounds
Water, to make	5 gallons

Mr. R. M. Chapin of the United States Bureau of Animal Industry has proposed that arsenic be dissolved in caustic soda solution by heat of chemical reaction and refers to such a preparation as self-boiled arsenic solution, or S-B cattle dip. Solution may be made as follows:

Dissolve the caustic soda in two gallons of water in a metal or wooden vessel (preferably iron) and while still hot, add the dry arsenic trioxide in a fine stream at a sufficient rate so that the solution is just at the point of boiling, but does not actually boil. Considerable heat is produced by dissolving the caustic soda. Additional heat is furnished by the chemical reaction when the caustic soda unites with the arsenic to form sodium arsenite. If the arsenic is added just at the right rate, no extra heating will be necessary. After the arsenic is all dissolved, *let the solution cool* and add water to make five gallons.

Caution! Do not add cold water to the hot solution, as an explosion may result for the reason that the solution is considerably hotter than the boiling point of water.

If for any reason the arsenic fails to dissolve without the use of heat, the materials have not been wasted, as a solution can then be made by warming the mixture slightly, unless the chemicals are of low grade. If hard water is used, there will be some insoluble matter in the solution, but it may be disregarded unless in very large amount.

This makes a convenient stock solution for diluting to any desired strength; that is, each gallon contains four pounds of arsenic trioxide; a quart, one pound; each fluid ounce contains one-half an ounce of arsenic trioxide.

SUGGESTED DILUTIONS FOR EXPERIMENTS.

As previously stated, the proper strength of chemical to be used has not yet been determined. For those who wish to conduct independent experiments on this point, the following dilutions may be tried out:

Formula 1 diluted to 1 or 1½ gallons.

Formula 2 diluted to 20 or 25 gallons.

Two fluid ounces of Formula 3 diluted to 1 or 1½ gallons.

One quart of Formula 3 diluted to 20 or 25 gallons.

One gallon of Formula 3 diluted to 80 or 100 gallons.

For use on agricultural lands the arsenical should be applied by means of an efficient hand or power sprayer in preference to a sprinkler. Neither the amount of arsenic which can be tolerated by the soil nor

the amount necessary to permanently sterilize the soil along roadways, etc., has been determined, but is under study. A liberal application of Formula 3 diluted one to ten or one to twenty might be tried where injury to the soil is of no consideration.

"DONT'S."

Don't handle or use arsenicals or corrosive chemicals without first familiarizing yourself with their properties and behavior.

Don't purchase arsenicals without a reliable guarantee of the percentage of arsenic.

Don't be fooled by secret preparations or use them without knowledge of their composition.

Don't use too small a vessel for dissolving arsenic.

Don't inhale the steam from boiling arsenicals.

Don't breathe any of the fumes if any arsenical is accidently spilled upon a hot stove or into a fire.

Don't boil water, sugar, and white arsenic with any of the solvents for arsenic.

Don't breathe any of the dust caused by handling powdered arsenicals or caustic soda.

Don't make large quantities of stock solution in a closed room.

Don't splash the solutions.

Don't spray forage plants with poisons without taking precautions that they will not be eaten by live stock.

Don't breathe the smoke when burning brush which has been treated with a heavy application of arsenicals.

Don't put any soluble arsenical upon the foliage or roots of trees or cultivated crops.

Don't use arsenic too liberally.

SOME RESULTS OF EXPERIMENTS.

Sufficient progress has been made in the experiments to warrant the following statements:

1. Under certain conditions the leaves and stems of plants are able to absorb enough poison from a single spraying to kill their roots to a depth of several feet.

2. Arsenical herbicides as generally used in California have been too concentrated to produce the best results.

3. Strong arsenicals liberally sprinkled upon agricultural land are apt to injure the soil. Two experimental plots of one square yard each, heavily infested with morning-glory, were each uniformly sprinkled with a solution made by diluting one fluid ounce of the stock solution as given in Formula 3 to one gallon. Each plot, therefore, received one-half ounce of arsenic trioxide. From the time of treatment to the present writing, a period of five months, all plant growth has been prevented, with the exception of a few morning-glory plants, notwithstanding the washing effect of the heavy winter rains. The growth of the morning-glory and native weeds and grasses, however, is luxuriant in the adjoining untreated field. The soil in these experiments was apparently injured by the application of one-half ounce of arsenic trioxide per square yard.

4. Spraying is usually more economical than sprinkling, and the effect on the soil is apt to be less injurious, as much less poison is required.

5. Morning-glory and many other plants can be killed to the ground without apparent injury to the soil by *spraying* with a solution of one gallon of the stock solution given in Formula 3 diluted to one hundred gallons. In some of the experiments the roots also of the morning-glory have been killed to a depth of over four feet by this treatment, but the roots are not always affected. The conditions necessary to kill the root system of morning-glory by the spray method are still unknown, but an attempt is being made to determine them.

6. It seems evident that the maturing of seeds on noxious weeds can be economically prevented by the spray method, provided the conditions are such that the spray can be applied without injury to cultivated crops. Weeds growing along canals, roadways, and fences, or other places where cultivation is difficult or impossible, would not be such a menace to the fields if the tops were killed to the ground at sufficiently frequent intervals to prevent their maturing and scattering seeds.

For this purpose a spray of sodium arsenite is recommended, equivalent to 4 pounds of arsenic trioxide per 100 gallons of water, to be applied to the foliage as a fine mist by means of an efficient hand or power sprayer.

A spray of practically the above concentration may be made as follows:

Formula 1, diluted to 1½ gallons.
Formula 2, diluted to 25 gallons.
Two fluid ounces of Formula 3 diluted to 1½ gallons.
One quart of Formula 3 diluted to 25 gallons.
One gallon of Formula 3 diluted to 100 gallons.

The writer wishes to acknowledge the assistance of Mr. William Wood, Horticultural Commissioner of Los Angeles County; Mr. Fred Seulberger, Horticultural Commissioner of Alameda County; his chief deputy, Mr. D. P. T. McDonald; Horticultural Inspector Mr. W. H. Tyson; Mr. A. A. Brock, Horticultural Commissioner of Ventura County; Mr. C. W. Beers, Horticultural Commissioner of Santa Barbara County; Mr. F. W. Waite, Horticultural Commissioner of Imperial County; Mr. Fred Lowrie and Mr. George Lowrie of Centerville, who have facilitated the experimental work in various ways through encouragement, offering transportation when needed, furnishing land for the experiments, and conducting independent experiments; and of their assistant, Mr. C. C. Barnum, who has been of invaluable aid in the planning and execution of the experiments.

THE POMEGRANATE.

By Robert W. Hodgson, University of California, Berkeley.

HISTORY AND DISTRIBUTION.

The pomegranate is among the fruits of the greatest antiquity. Long before the almond, apricot, peach or nectarine had been disseminated from Persia westward to Asia Minor, the pomegranate was cultivated there and very highly esteemed. At an early date it was taken by the Phœnicians to Northern Africa. In later years the Carthaginians took it to Rome and it received its Latin name, *Malum punicum,* from this

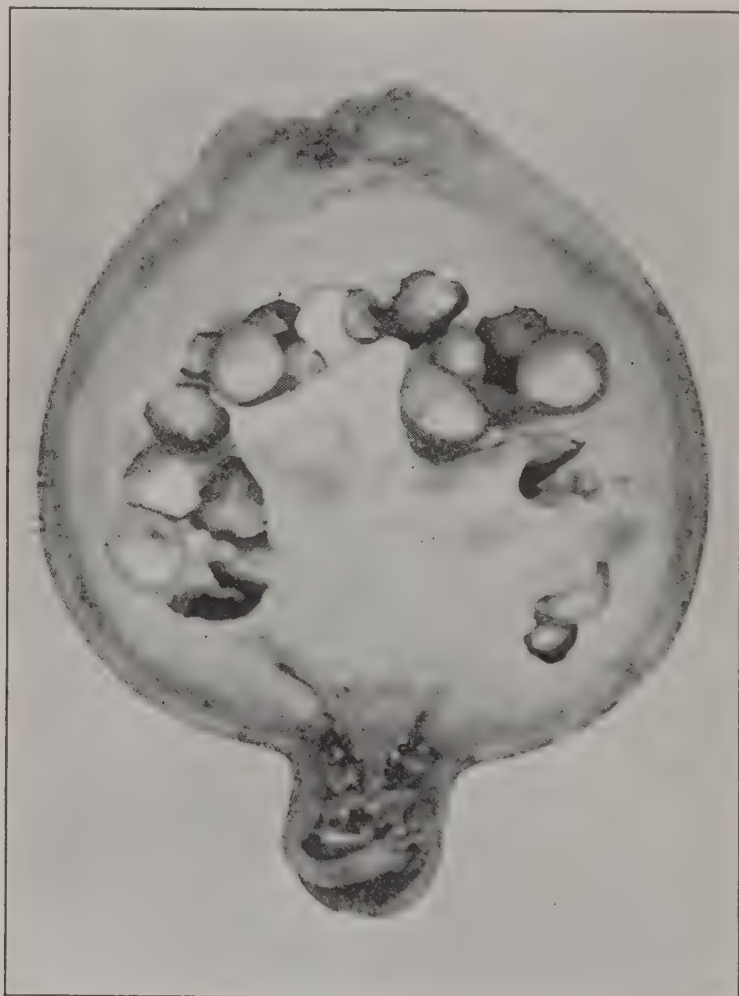


Fig. 48.—A poor type of pomegranate. Note the amount of rag, the thick skin and protruding calyx. The flavor is poor and the seeds are large, bony and inedible. (Original.)

fact. It undoubtedly was early introduced into Greece, as Theophrastus described it 300 years before the Christian era. The pomegranate is mentioned several times in the Old Testament and was evidently held in high esteem, for Solomon sings of "An orchard of pomegranates with pleasant fruits." The Israelites had become familiar with it in Egypt, for in the wilderness they murmured for "the fruits of Egypt, the fig, the vine, and the pomegranate." Many localities in Palestine took their

names from the shrub. The fruit and flowers entered largely into the religious rites of the Phœnicians. There is the myth that the goddess Aphrodite herself planted it in the Isle of Cyprus, which implies that it was not indigenous there. It has always been grown in China as a cultivated plant, having been introduced about 150 B. C. The fruit is often mentioned by Roman authors; Pliny considered it a most valuable fruit and declared that the best fruits came from Carthage. The pomegranate was probably carried westward by the Romans to France and Spain and also by the Arabs to Northern Africa and thence across into Southern Europe. Granada in Spain owes its name to the far-spread fame of its pomegranates, the fruit reaching a high degree of perfection in its gentle climate. The first mention of the pomegranate in England is during the reign of Henry VIII. At that time the fruit was introduced and was highly prized as an ornamental, but did not mature in the open. It is now a common greenhouse plant there. In 1829 it is mentioned as having grown and fruited in Versailles, France, for more than two centuries.

At the present time the pomegranate is a common fruit in the Mediterranean countries and its culture has reached a high state of perfection in favored localities. The fruit is grown to some commercial extent in Spain, Southern France, Italy, Greece, the Balkan States, Southern Russia, Palestine, Persia, India, China, the Malayan States, Northern Africa, Mexico, and Southern United States, mainly Arizona and California. The fruit was brought by the Spanish to Mexico very early and was introduced into California by the mission fathers at the founding of their oldest mission, Mission San Diego, in 1769. It is grown to a small extent through the East and North as a hothouse plant in tubs. The plant blossoms but rarely fruits as far north as Raleigh, North Carolina.

From the old missions the pomegranate has spread widely through California under the common name of mission pomegranate. Varieties have been imported, mainly from Mediterranean countries, but also from China. Most of the plantings up to a recent date were seedlings, so that the collection is large and varied and furnishes excellent material for selection of good varieties, several of which have appeared as seedlings. The plant flourishes from one end of California to the other, doing especially well in the warm interior valleys. Here the fruit reaches the highest perfection, attaining a large size, brilliant color, and rich, sprightly flavor. It is an early and abundant bearer. The largest plantings are in the San Joaquin, Imperial, and Coachella valleys.

BOTANY AND GENERAL DESCRIPTION.

The generic name *Punica* is derived from the Latin name *Malum punicum*; the specific name *granatum* refers to the grain-like seeds or kernels.

The plant is a large shrub, bushy in growth, usually deciduous, though some of the tropical varieties, notably one from Porto Rico, hold their leaves till spring. The leaves are mostly opposite, lanceolate, long, or obovate, obtuse, entire, glabrous, red veined, and bright glossy green. The branches are slender, twiggy, nearly cylindrical, somewhat thorny, the new growth being four-angled. The flowers are axillary,

solitary, or in small clusters, with a stiff tubular, showy, orange or red calyx, lobes five to seven, crowned with bright scarlet, or white crumpled petals, lanceolate to obovate, equal in number to the sepals and inserted between them. The stamens are numerous and are inserted on the inner wall of the calyx tube. The ovary is embedded in the calyx tube or receptacle and consists of seven to fifteen locules in two series, one above the other, ripening into a large, many-seeded pome-like berry, crowned with a large persistent calyx. The flowers are from one to one and one-half inches in length and the fruits vary from three to six inches in diameter. The external portion of the seedcoat becomes succulent, forming an arillus, and the arils comprise the edible portion of the fruit. These range in color from white to a bright crimson and are arranged in very irregular loculi, which are

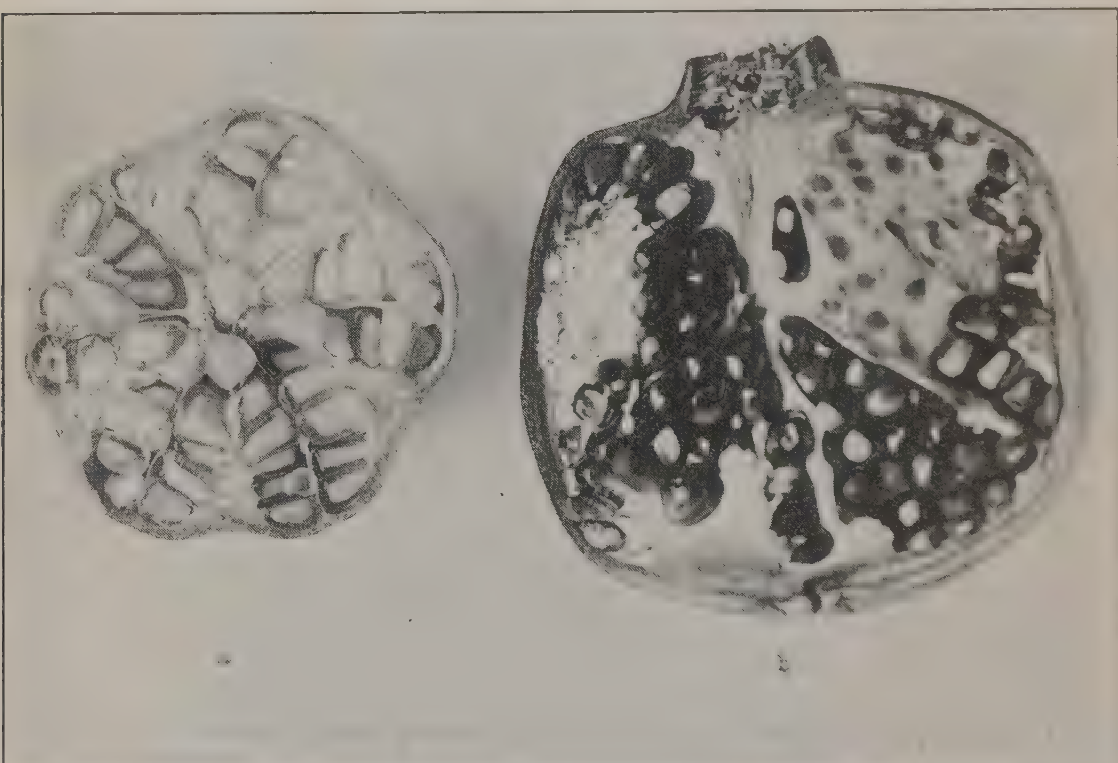


FIG. 49.—*A*, a good type of light fleshed pomegranate, a paper-shelled variety. The rag is small in amount, the skin thin, and the seeds moderately large but soft and edible.

B, a good type of pomegranate. This fruit was cut open twenty-four days before the photo was taken. Note the fresh appearance. The pomegranate is a remarkable keeper. (Original.)

separated by a thin astringent membrane. The rind of the fruit is tough and leathery and varies in color from pale yellow to deep purplish red.

The plant is well adapted for hedges, having a strong tendency to sucker from the roots and crown of the tree. By careful and persistent pruning it may be trained into a small tree, sometimes reaching a height of twenty feet.

It is essentially a desert plant and is well adapted to standing long periods of drought, but fruits little under these conditions. It may be found still alive, not growing, but holding its own, on old abandoned homesteads in the deserts of southern California and Arizona and, on

the application of water, will quickly recover and fruit again. On account of its drought resistance it would seem that more general planting of the better varieties would be justified. For the proper maturing of the fruit a large number of heat units is necessary, and for this reason the pomegranate is most successful in the hot interior valleys. It seldom ripens well near the coast, usually remaining very sour and tart, and poorly colored. The plant will stand almost any amount of heat but is injured by temperatures of eight to fifteen degrees Fahrenheit, and frozen to the ground by zero temperatures. It is not hardy above thirty-four degrees of latitude. It blooms late, in April and May, and so escapes danger from spring frosts. The fruit ripens from October to December.

CULTURE AND PROPAGATION.

Investigations by the California Station during 1894 and 1895 in regard to alkali resistance showed that the pomegranate is one of the most resistant plants, all varieties being apparently equally resistant. It is grown very successfully throughout the State and elsewhere on widely different soil types and has not proven to be particular in regard to soils. Heavy soils, especially those with plenty of lime, seem to give the best results. For healthy, vigorous fruiting moderate irrigation is required.

The pomegranate is very easily propagated by hardwood cuttings, either calloused in sand over winter and set out in the spring, or planted immediately. A very high percentage of cuttings will grow. Seeds germinate readily but should not be used, as they do not come true to type. In a study of variation in seedling pomegranates made last year by the writer, it was found that the normal range of variation is very wide. Every degree of color in fruit and flesh from pale yellow to deep crimson was observed. Widely varying lengths of calyx tube and sepals, thicknesses of rind, hardnesses of seed, amounts of pulp and flesh were found. Propagation should always be by cuttings from a plant of known desirable type.

The plant is most commonly grown in hedge form or as border trees, though a few plantings are made on the square system at a distance of fifteen to twenty feet each way. In hedge form the trees may be as close as eight feet. Clean summer tillage is practiced where any cultivation is given. A system of straw mulching should serve the same purpose better and would probably be cheaper.

Practically no pruning is done, other than cutting out interfering branches and dead wood. An occasional thinning out to encourage new wood formation should be given the tree, though care must be taken not to remove too much, as the fruit is borne on short spurs on old wood. Fruit should be clipped from the tree, as the spur is firmly attached to the rind and if pulled off the fruit is usually injured. The pomegranate is a remarkable keeper and if handled carefully may be kept in good condition three or four months and in many cases even longer. The rind shrivels and becomes hard and tough but the interior remains fresh and juicy. I have broken a fruit open, placed the halves in a paper bag and six weeks later the arils were as fresh and plump as the day the fruit was cut, and no decay whatsoever had set in where the arils themselves had not been broken.

MARKETING AND PROFITS.

The pomegranate is marketed for consumption fresh and for decorative purposes. There is a considerable demand for the fruit for use in decorating other fruit packages, banquet tables, peddlers' carts, and the like. The market demand is quite small, however, and the market is easily flooded. The usual package is the half orange box, containing from thirty to thirty-five pounds. Orange wrappers are commonly used and the fruit is packed much the same as oranges. The prices quoted for these half boxes range from 65 cents to $1.50 during the season on the San Francisco market, the average price being about 75 cents. The fruit retails early in the season at three for 25 cents, later at five cents, and rarely gets below three for 10 cents in the San Francisco Bay region. Individual trees are known which regularly produce ten to fifteen such boxes. Some growers testify that they make more from their pomegranates than from their oranges. For eastern shipment a few boxes of the fruit in a carload of oranges are usually sent, as the demand is small. A few growers are making big profits on their pomegranates in this way.

USES.

From ancient times the Mediterranean peoples have used the pulp of the pomegranate in the making of acescent and cooling drinks. The juice is particularly satisfying during dry hot weather. The people of Southern Russia and Armenia make a commercial drink from the juice. It is called "Nosharab," and is said to be very pleasant to the taste. In France the juice is mixed in certain proportions with grape juice and wine, and a wine is made which is highly esteemed.

The fruits are commonly eaten out of hand and are much liked by those who are accustomed to them. There is a knack in opening the fruit and shelling out the "berries," or grains, which the novice only acquires with practice, but at which the Mexicans and Southern Europeans are very dexterous. The less acid varieties have a rich, sprightly flavor which is much relished. The pulp is often recommended as a tonic by physicians and the bark of the root furnishes a well known astringent used in treating dysentery. The rind of the fruit furnishes a jet-black ink and an extract from it is used as a remedy for tæniasis or tapeworm. A dye is extracted from the bark which is used in staining leather. The juice is much used as a coloring fluid employed in confectionery, mixing drinks, and making punch. When sterilized and put up in bottles similar to grape juice it is excellent and preferred to the grape juice by some. A fair grade of claret can be made from it. Grenadine syrup as sold in this country today contains no pomegranate juice. Very good jelly can be made if the rind of an orange or lemon is added to furnish the pectins.

An analysis by the California Station in 1903 shows: Water, 76.8; protein, 1.5; fat, 1.6; sugar, starch, etc., 16.8; crude fiber, 2.7; ash, .6.

VARIETIES.

There are two general types of pomegranates found today in California, differing but little in tree characteristics but widely different as to fruit.

White-Flowered Type.

The white-flowered type has been introduced within the last fifteen or twenty years. Some of the varieties under this type are deciduous, and some are evergreen. The fruit is either round, oblate or obovate in form, according to variety. It is always a pale lemon yellow or fawn color; the rind is invariably thick and soft; the pulp or rag is medium to large in amount; the arils are large, pale white, translucent, and the seeds are large to very large, with thick, bony coats which render them absolutely inedible and difficult to chew. The fruit from this type is very poor in appearance, keeps poorly as compared to the other type, and the flavor is flat and insipid, lacking the acid element. The fruits are easily bruised and the bruises show up very quickly as ugly brown blotches which detract greatly from the appearance of the fruit. This type is undesirable.

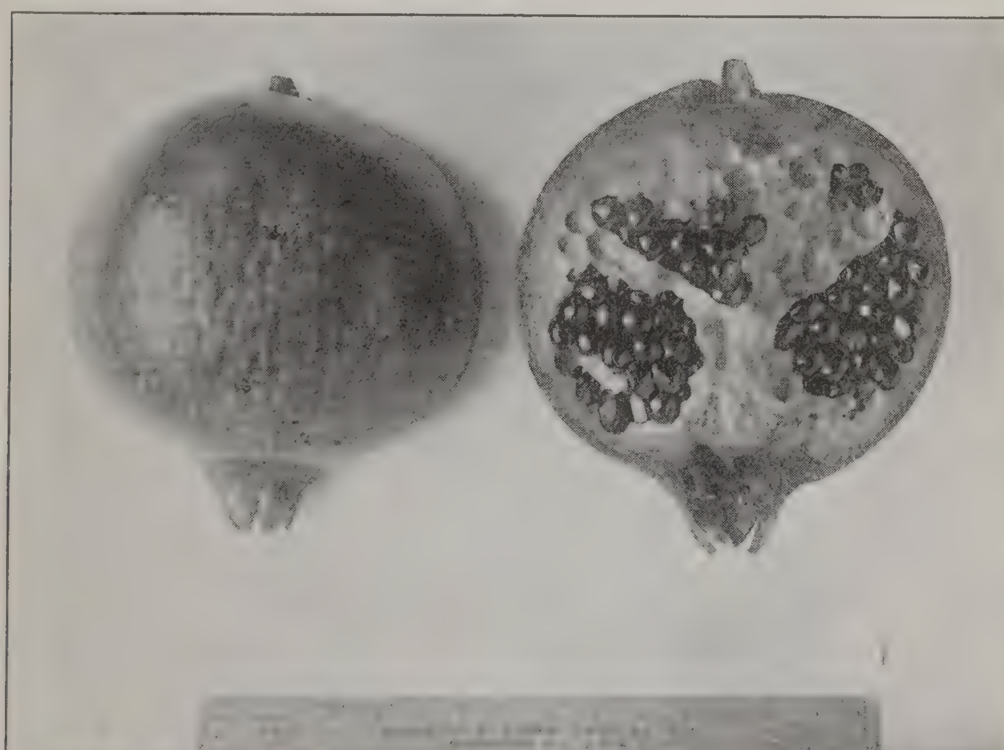


FIG. 50.—The wonderful pomegranate. This is the best commercial variety now grown in California. It combines a rich flavor with dark-colored flesh and juice and small edible seeds. It is an excellent keeper and shipper. (Original.)

Pink or Red-Flowered Type.

The pink or red-flowered type includes the varieties commonly found, and all the desirable varieties belong to this type. The leaves always fall before Christmas. The fruit is round, oblate or obovate in form, according to variety; the rind varies from thick to very thin; the pulp or rag is small to large in amount; the arils are small to large, pale pink to bright crimson in color, and the seeds are small to medium, ranging in hardness from the so-called seedless varieties in which the seed is edible, to very hard and bony. The fruits vary in color from a pale lemon yellow washed in light pink to a bright crimson with a deep purplish tinge.

The Requirements of a Good Commercial Fruit.

1. It should be medium to large in size, pink to bright red in color, with a high degree of reflection.
2. The calyx-tube should be medium to short, lobes reflexed or inflexed.
3. The rind should be thin to medium, tough, and well adapted to shipping.
4. The flesh should preferably be bright red or crimson, and large in amount.
5. The pulp or rag should be small in amount.
6. The seeds should be small in proportion to the aril, and should be tender and readily edible.
7. The juice should be dark colored and plentiful.
8. The flavor should be rich, sprightly, and subacid.

A complete list of varieties would be long but there are only five important varieties commonly found on the market. Of these, the Wonderful, a seedling originating on Mr. Barss' place at Porterville is by far the most promising.

Wonderful. Large and attractive; deep purple red, glossy; flesh deep crimson, juice abundant, deep crimson, flavor excellent, rich and sprightly; seeds fairly tender; calyx medium. A good shipper.

Paper Shell. Large, attractive; pale yellow washed in pink, glossy; flesh bright red, juice abundant, bright red, flavor good; seeds fairly tender; rind very thin; calyx small. Good for home use.

Spanish Ruby. Large, attractive; bright red, glossy; flesh deep crimson, juice abundant, flavor sweet and aromatic; seeds fairly tender; rind medium; calyx medium. Good shipper.

Sweet Fruited. Medium; pale yellow, lightly striped in pink; flesh pale pink, juice moderate in amount, flavor sweet and aromatic; seeds fairly tender; rind medium; calyx medium.

Sub Acid. Medium; pale yellow washed in pink; flesh clear red, juice moderate in amount, very tart and sour; seeds not edible but readily chewed; rind thin; calyx large.

Other varieties found to some extent are the Radinar, Dessia, and Sin Pepitas. The last is the so-called seedless variety. There is no such thing as a seedless pomegranate; the seed coats of some, however, are very soft and readily edible.

DISEASES.

Sterigmatocystis castanea, or heart rot. This disease shows itself only when the fruit is broken open and its worst feature lies in the fact that its presence can not (for a time) be detected from the exterior of the fruit. The pomegranate looks perfectly normal, highly colored and firm, but when opened is found to be a black mass of decayed material discharging myriads of black spores. In some cases only one or two locules will be infected but the remaining arils will be flat, insipid and pale colored. How this disease is introduced into the fruit has not been determined. At the present time the disease is confined to small areas in the Imperial Valley but if it ever becomes widespread the industry may be seriously injured. The sensation one experiences on opening a beautiful fruit only to find a nauseating mass

of decay is not soon forgotten, or conducive to further purchase. Careful investigation and study of this disease is needed.

Alternaria. This disease begins at the blossom or stylar end of the fruit and is introduced into the fruit while it is quite small and immature. The presence of the disease can not be detected from the external appearance, but is revealed on opening the fruit. There is a breaking down of the arils, a loss of color and flavor, and finally a slimy decaying mass results which is quite nauseating to view. Fortunately this disease is as yet quite rare.

Splitting. The pomegranate is very subject to splitting at the ripening period. The degree of splitting varies much with localities, varieties, and individual trees. In some localities splitting is uncommon, in others some varieties are very prone to split, while in still other localities some do and others do not split. This splitting may be very bad on one tree and not present on the adjoining tree. The fruit splits open, disclosing the arils to view. As the fruit matures the split widens and the arils are dehisced much as peas from the pod. This trouble is thought to be due to sudden fluctuations in moisture content of the soil and air, caused by lack of irrigation at proper intervals, or dry north winds followed by heavy irrigation. Any condition causing these sudden fluctuations may cause splitting. This trouble is quite serious in some sections, but the causes are not yet understood.

THE MONTHLY BULLETIN

CALIFORNIA STATE COMMISSION OF HORTICULTURE.

DEVOTED TO HORTICULTURE IN ITS BROADEST SENSE, WITH SPECIAL REFERENCE TO PLANT DISEASES, INSECT PESTS, AND THEIR CONTROL.

Sent free to all citizens of the State of California. Offered in exchange for bulletins of the Federal Government and experiment stations, entomological and mycological journals, agricultural and horticultural papers, botanical and other publications of a similar nature.

A. J. Cook, State Commissioner of Horticulture------------------------------Censor
E. J. Vosler, Secretary State Commission of Horticulture--------------------Editor

ASSOCIATE EDITORS.

Geo. P. Weldon--------------------------------------Chief Deputy Commissioner
Harry S. Smith------------------------------------Superintendent State Insectary
Frederick Maskew--------------------------------Chief Deputy Quarantine Officer

Entered as second class matter December 29, 1911, at the post office at Sacramento, California, under the act of July 16, 1894.

Olive Quarantine.—Arizona has issued the following quarantine against the importation of olive trees from other states. This quarantine became effective April 1, 1916:

Arizona Commission of Agriculture and Horticulture.

PHOENIX, ARIZONA.

QUARANTINE ORDER NO. 12.

Olive Quarantine.

In order to protect the olive industry of Arizona against the introduction into the olive orchards of the state of the several insect pests and plant diseases known to exist in other olive growing districts, it is hereby ordered and declared:

That the further importation of olive trees, nursery stock and rooted cuttings from other states and from foreign countries is prohibited.

That unrooted olive cuttings may hereafter be imported into the state and provisionally released only under quarantine, and all such imported cuttings are subject to final release if found free from pests by Arizona inspectors only after the expiration of one year from time of importation.

That all persons, corporations and common carriers are hereby prohibited from having possession of, transporting, selling or giving away rooted olive cuttings or olive trees grown in or shipped from other states or foreign countries except as provided herein, and that this order is hereby declared effective April 1, 1916.

Adopted March 1, 1916.

A Matter of Interest to Fruit Growers.—For more than thirty-three years horticultural quarantine has been an established institution in California. During this period the quarantine officers of the State by and with the support of the fruit growers have employed every means in their power to improve and perfect the service. The end always in view has been an institution which would provide the maximum degree of protection to the horticultural and agricultural interests of the State. In looking over the records of horticultural quarantine a

point worthy of note is the very small number comparatively of the shipments of horticultural material coming into California which show, by any of the conditions of packing, marking or billing, that an attempt had been made to evade the horticultural regulations.

One such case which came recently to the attention of the quarantine officers operating in Los Angeles possesses, in the mind of the writer, such interest and importance as to justify the publication of the same

FIG. 51.—Florida grapefruit infected with *Phomopsis citri*, taken by the quarantine officers at Los Angeles, February 24, 1916. Note method of packing. (Photo by C. H. Vary.)

with the recommendation that it receive the careful consideration of every reader of the Monthly Bulletin who is interested in the fruit industry of the State.

Billed as apples from Salt Lake City, Utah, the barrel herewith illustrated contained two layers of apples at top and bottom respectively, the remaining space being filled with Florida grapefruit badly affected with the fungous disease known as Melanose (*Phomopsis citri*), protected from the possible intrusion of the inspector on the sides by layer after layer of apples carefully packed between the grapefruit and

the barrel staves. Moreover the apples contained in this barrel were of a grade so inferior as to give rise to the suspicion that they were used because they were the cheapest obtainable for the purpose in view. The accompanying photograph, taken just prior to the destruction of this shipment, endeavors to represent the method of packing by substituting the first layer of grapefruit surrounded by apples for the two top layers of apples. Close examination of this illustration shows the word "apples" in heavy black pencil on the head of the barrel, and over a shipping tag of the Utah Vegetable Company, Salt Lake City, Utah, had been pasted a printed label as follows: "American Express Company, D. H. Frank No. 3844 From Douglas White General Industrial Agent Salt Lake Route to Douglas White, Pacific Electric Bldg., Los Angeles, Cal."—AVERY S. HOYT.

Citrus Canker.—In order to further acquaint the citrus growers of California with the deadly character of citrus canker we are publishing herewith a letter from Professor Wilmon Newell, Commissioner of the Florida Plant Board. Citrus canker does not exist in California, and it is one of our sincerest hopes that it never will:

STATE PLANT BOARD OF FLORIDA.
GAINESVILLE, FLORIDA, February 24, 1916.

MR. A. R. GREGORY,
Care Hon. James Rolph, Jr.,
Mayor's Office,
San Francisco, California.

DEAR SIR: I have your favor of February 15th, from which I note that you are desirous of testing a carbon sulphur solution as a remedy for citrus canker, and also that ______________ advised you to come to Florida to see whether you could make tests of this kind upon citrus canker in this State. It is very difficult for a person who has not had actual experience with extremely dangerous and infectious diseases, such as bubonic plague, foot-and-mouth diseases, etc., to understand what thorough precautions must be taken in dealing with citrus canker.

I note from your letter that you would like to have, say, three one-acre blocks of canker infected trees upon which to conduct your experiments. We could no more think of permitting three acres of canker-infected trees to remain standing for experimental purposes than we could of blowing up our State Capitol with dynamite. The disease is so deadly and so infectious that every infected tree is destroyed, as soon as discovered, with a burning oil spray without any person or anything being allowed to come in contact with the tree or nearer to it then absolutely necessary for its destruction with the burning spray.

I do not know of a single canker-infected tree standing in the groves or nurseries of Florida today, and if we did know of anything of the kind it would not be standing tomorrow. It is out of the question for us to permit any experiments with citrus canker except under the direct personal supervision of our own Plant Pathologist, and all of his experiments are conducted in very strong doubly screened cages where the most thorough precautions imaginable are taken in the way of disinfection. Even the Plant Pathologist himself, after being in a compartment where there is a canker-infected tree or an inoculated tree, disinfects his person and his clothing when leaving. Our inspectors also, when seeking for canker in the groves, wear special inspection suits covering their entire clothing, and when leaving a property thoroughly disinfect these suits, their hands, face, hat, and shoes with corrosive sublimate solution, regardless of whether they have found canker or not.

For your information I will say that practically everything which has ever been found successful against a plant disease has been tried against citrus canker, absolutely without success. In fact, sprayings with the very strongest fungicides that can be used on growing plants have only resulted in spreading the disease. We are

very anxious to have some control measure for citrus canker, and we are working in this direction ourselves as rapidly as possible; but it must be admitted that the chances for a successful cure or remedy are extremely remote. The chances of anything being accomplished along this line are so very small that we would not be justified in permitting any canker-infected trees to stand for a minute longer than necessary, even for experimental purposes.

It is even necessary to put under quarantine for many months the properties in which canker-infected trees have been found, and no one is allowed to go into such properties except under the supervision of our inspectors and with the practice of very rigid disinfecting precautions. The only way that we could consider any test of your treatment would be for you to submit the material to us with a statement as to its nature and have it tested by our Plant Pathologist in our special laboratory. As the number of supposed remedies offered for our consideration run into the hundreds, we can not even consent to test this preparation unless after a careful examination of your claims we can see that they possess some promise of possessing hope or merit. It has been found absolutely necessary to prohibit people with canker cures, as well as other parties, from visiting infected properties in Florida, and we have to prosecute without favor any one who disobeys our rules in this regard.

We would not be in position to offer you any sum whatever for your formula, or in any way obligate the State Plant Board or the State of Florida to pay for it. I will say, however, that from your general statement I infer that your preparation is one intended for soil treatment, and if this is the case, I can assure you that there is absolutely no possibility of its being of any use in connection with citrus canker.

Very truly yours,

WILMON NEWELL, Plant Commissioner.

CROP REPORT ERRATA.

Volume V, No. 3, p. 104.

Total bearing acreage of apples, 39,210 instead of 38,410.
Total non-bearing acreage of apples, 23,630 instead of 22,430.
Total bearing acreage of apricots, 40,918 instead of 40,898.
Total non-bearing acreage of apricots, 14,578 instead of 14,553.

Volume V, No. 3, p. 105.

Bearing acreage of lemons in Tulare County, 625 instead of 62.
First column, under olives should be bearing instead of non-bearing, and second column non-bearing instead of bearing.
Total bearing acreage of olives, 16,054 instead of 15,854.
Total bearing acreage of peaches, 114,175 instead of 113,725.
Total non-bearing acreage of peaches 31,313 instead of 31,163.
Total bearing acreage of pears, 18,029 instead of 17,779.
Total non-bearing acreage of pears, 19,899 instead of 19,649.
Total bearing acreage of plums, 16,460 instead of 16,410.
Total non-bearing acreage of plums, 5,826 instead of 5,751.

THE YELLOW CURRANT AND GOOSEBERRY FRUIT-FLY.

Epochra canadensis (Lœw).

Order—Diptera. **Family—Trypetidæ.**

By L. A. Whitney, San Francisco.

Although the currant and gooseberry industry of the State is not as extensive as some of the other branches of horticulture, those who are familiar with the conditions that obtain in most sections where these fruits are grown will understand why section five of the State Quarantine Law is so rigidly enforced. While the insect referred to in this paper attacks only currants and gooseberries, it is closely related to various eastern and European forms, some of which take a much greater variety of diet than the one under consideration, and a study

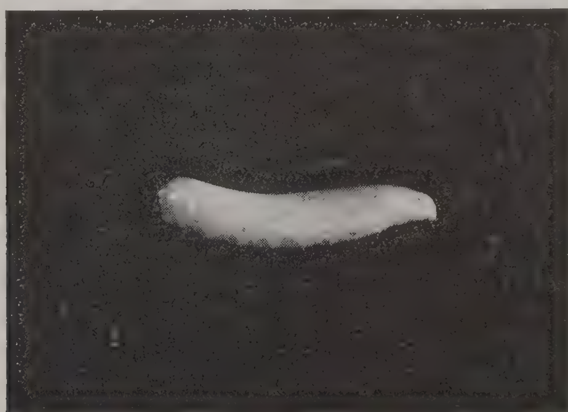


Fig. 52.—The larva of the yellow currant and gooseberry fruit fly, *Epochra canadensis*. Greatly enlarged. (Original.)

under natural conditions of this particular one will give an idea of the condition to be expected of some of our other fruits should quarantine regulations be withdrawn.

This fly is generally distributed throughout the currant and gooseberry growing districts of the United States and Canada, and is responsible for the unmarketable condition of much of the fruit in many localities.

The control of this family of insects is difficult indeed, as the manner of attack precludes all possibility of poisoning the larvæ, as successfully employed for certain other pests, of which the codling moth is a typical example. Sweet, poisoned baits seem to be the only hopeful solution of the problem, and if results similar to those obtained against the apple and cherry fruit-flies in New York State can be secured, the trial will certainly be worth the effort.

Following is a general description of the egg, larva and puparium from original observations, a description of the adult by Lœw from the Monographs of the Diptera of North America, and a resumé of the

results obtained at the Cornell Agricultural Experiment Station against the cherry fruit-fly:

THE EGG.

The eggs are oblong, shiny white, and are deposited in the fruit through a puncture in the skin which the female makes with the ovipositor, beyond the reach of all arsenicals and poisons. As the maggot develops a dark sunken area is formed around this puncture, which makes the infestation quite evident.

THE LARVA.

The larva (Fig. 52) is of the typical dipterous form, conical, white to cream colored and about one-fourth of an inch in length when fully matured. When this stage is reached the fruit usually drops and the maggot escapes and enters the ground to the depth of about one inch and pupates. Only one generation occurs each year.

THE PUPARIUM.

The puparium (Fig. 53) is oval, straw colored, plainly segmented, and is a trifle over three-sixteenths of an inch in length. This stage may be found any time during the fall and winter months in the soil around infested plants.

FIG. 53.—The puparium of the yellow currant and gooseberry fruit fly, *Epochra canadensis.* Greatly enlarged. (Original.)

THE ADULT (Figs. 55 and 56).

Pale clay-yellowish, with a brown crossband on the third and fourth abdominal segments, stature short and somewhat broad; ovipositor of medium length, broad and broadly truncate; wings with narrow pale brownish rivulets and with a fourth longitudinal vein which is not curved forward at the tip.

The head resembles that of *Trypeta fratria* in shape, only the front is somewhat broader, the vertical diameter of the eye is a little smaller; and the anterior edge of the mouth is more projecting. On the border of the front the described specimen bears, on each side, three long but rather weak black bristles. The antennæ are of a more saturate yellow, not reaching the edge of the mouth; their third joint is rounded at the tip; arista blackish, yellow toward the basis, with a very short pubescence. Rostrum and palpi are pale yellow, the latter not reaching beyond the anterior edge of the oral opening. Thoracic dorsum is of a very thin, whitish bloom, only the double middle stripe and the narrow lateral stripes not pollinose, rather shining and somewhat darker than their surroundings. The posterior end of the thoracic dorsum and the scutellum is likewise without pollen, shining, very pale yellow; a not very broad yellowish stripe runs from the humeral corner to the root of the wings. The scutellum is convex and not very large; in my specimen it

has three bristles on one side and only two on the other, so that I can not say whether the normal number of bristles of the scutellum is six or four. The bristles of the thorax and of the scutellum, as well as the short pile of the thoracic dorsum, are black; metathorax distinctly infuscated on its superior margin and its middle line.

The abdomen is shining, with short black pile; the third and fourth segments have, each at its basis, a chestnut crossband, interrupted upon its middle, while upon the second segment only a lateral beginning of such a stripe is indicated by a chestnut brown spot. The very broad ovipositor is flat, almost as long as the three last abdominal segments taken together, very broadly truncate and infuscated at the end. The front femora are sparsely beset with bristles on the upper and under side; the middle femora are entirely without bristles; upon the hind femora, likewise, there are only a few bristlelike hairs before the end of the upper side; the upper side of the hind tibia is merely beset with exceedingly short bristlelike hairs. Wings are of the usual shape, hyaline, with a pale brown picture; it consists: 1, in an oblique half crossband running from the humeral cross-vein to the basis of the second basal cell;

Fig. 54.—Showing the work of the yellow currant and gooseberry fruit fly, *Epochra canadensis*. (Original.)

2, of a crossband parallel to the first, abbreviated behind, which begins at the stigma, near the anterior margin, and runs across the basis of the submarginal cell, as well as across the cross-veins, which close the second and third basal cells, and thus reaches the sixth longitudinal vein; 3, of a rivulet which begins above the posterior cross-vein, near the third longitudinal vein, runs from it across the posterior cross-vein as far as the posterior margin, and is continued along this margin inside of the third posterior cell, but, before reaching the sixth longitudinal vein, is suddenly turned upwards, running parallel to the band which begins at the stigma, crossing the small cross-vein, and thus reaching the anterior margin, where, gradually expanding, it forms a border ending a little beyond the tip of the fourth cross-vein.

The two crossbands, as well as the rivulet, are of moderate breadth only; the latter has, in the described specimen, the following faded spots, which in more fully colored specimens are probably less apparent or altogether absent: 1, a rounded spot in the marginal cell, above the origin of the rivulet; 2, upon the longitudinal axis of the submarginal cell an indentation in the inner margin of the section bordering the apex of the wing; 3, upon the longitudinal axis of the first posterior cell an interruption of the rivulet at its origin and an indentation in the inner margin of the portion bordering the apex of the wing; 4, upon the longitudinal axis of the discal cell a narrow interruption of the section, running again toward the anterior margin; 5, the spot upon the posterior margin connects the first, descending portion, with the second, which rises again upward. The first and third longitudinal veins are bristly;

the third and fourth are parallel towards their end, both very gently curved backwards; the section of the fourth vein preceding the discal cell is gently, but rather distinctly arcuated backward, so that the shape of the discal cell somewhat reminds of that of the species of *Rivellia;* the cross-veins are comparatively rather long, moderately approximated, their distance being about equal to the length of the posterior cross-vein; the latter is rather steep, however, perceptibly approximated to the apex with its anterior end, more than with the posterior; the posterior corner of the anal cell is very much drawn out in a point.

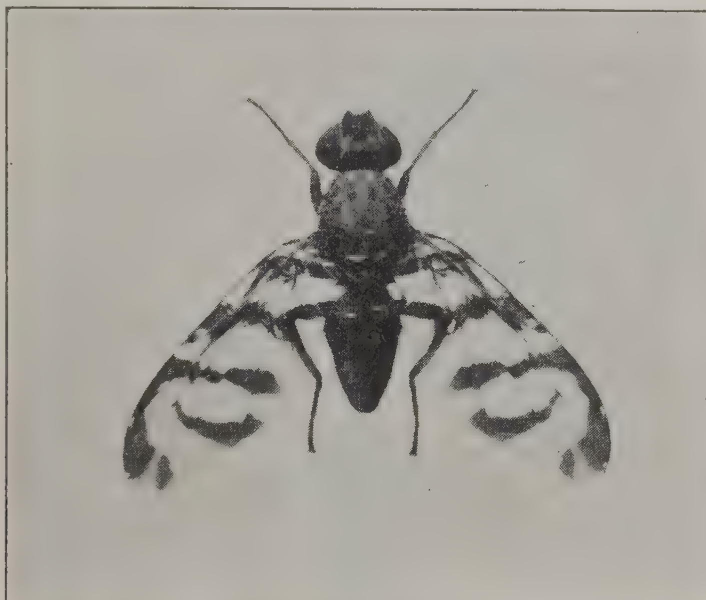


FIG. 55.—The male of the yellow currant and gooseberry fruit fly, *Epochra canadensis.* Enlarged. (Original.)

DISTRIBUTION.

In California this insect is apparently confined to the central and northern parts of the State. It is also distributed throughout the northern and eastern states and Canada.

CONTROL.

[The following is adapted from Bulletin 325, Cornell University Agricultural Experiment Station, "Cherry Fruit Flies and How to Control Them."]

* * * The block of Montmorency trees that was chosen for the experiment was so badly infested the previous year that the fruit was not picked at all.

The spray was not applied until the flies appeared, since, according to observations on apple flies, it was thought that the eggs would be about two weeks or more in developing after the flies emerged. The cherries were more than half grown and some of them were turning red when the first flies appeared, June 8. * * *

The orchard was four rows wide and sixteen long. The plan decided on was to divide it, spraying eleven of the short rows and leaving the last five rows for a check. Since so little of the sweetened arsenate is

required, a brass syringe, holding just a pint, was found to be the most satisfactory implement for applying the poison. * * * The first spraying was done on June 10th, the bait being made as follows:

Arsenate of lead	3 ounces	or	5 pounds
Cheap molasses	1 pint	or	3 gallons
Water	4 gallons	or	100 gallons

No heavy rains followed, which was favorable to the experiment. No flies were found on the sprayed trees after a few days, and even on the check trees they became very scarce by the 24th of June, when the first females were observed ovipositing. * * *

Although no flies could be found on the sprayed trees, a second treatment was given on June 24th in order to insure safety. No flies could be found even on the check trees after June 30th, and it was feared that all the flies had succumbed to the treatment before they had

FIG. 56.—The female of the yellow currant and gooseberry fruit fly, *Epochra canadensis*. Enlarged. (Original.)

deposited enough eggs in the checks to give results. By July 8th, however, numerous half-grown maggots were discovered in the last row of the checks. The fruit on rows 12, 13 and 14 appeared to be fairly free of infestation. The brown rot developing in most of the cherries that contained maggots made it an easy matter to find them. A slight infestation showed on the last two rows (10 and 11) of the sprayed trees, but the others were remarkably perfect. There was also very noticeable lessening of brown rot and curculio injury on the sprayed fruit.

Two crates (sixty-four quarts) of apparently perfect fruit were picked on July 12th from the two middle trees of the first sprayed row. All this fruit was opened in order to determine whether any maggots were in it. The first crate, most of which was picked from the top of a rather tall tree, developed seventeen maggots, while the second crate had only two. A careful estimate of the number of cherries in the two crates was 12,800, making an average of about 674 perfect cherries to one cherry that contained a maggot. A careful estimate was made also by picking about a crate of fruit from the check trees. This fruit was so badly affected by the brown rot and curculio that it was hard to get a correct record. Fully one-third of

the fruit on the sixteenth row contained maggots; the other check rows showed less and less infestation, the nearer they were to the sprayed trees. The fruit from the last sprayed row (11) was almost equally infested with that of the first check row (12).

All the evidence, therefore, appears to show that the flies are easily poisoned, and that they travel about from tree to tree for a considerable distance from the place where they first emerge. Flies from the check trees evidently went over to the sprayed section and deposited a few eggs before they finally succumbed to the poison. This seems to be the only way of accounting for the greater infestation of the last sprayed row.

SUMMARY.

From the foregoing it would appear that the cherry fly can be controlled successfully, but as some insects are more easily attracted by sweet substances than others, it is doubtful if this remedy would apply in all cases. However, with the insect under consideration, specimens reared in confinement have proven very easily attracted by sugar water placed in the breeding jar. Whether this would hold good under field conditions I am unable to say, but at least it should prove a very interesting and inexpensive experiment for some one who is properly situated.

The records at this office show that adults emerged, under laboratory conditions, from February 23d to March 11th, but emergence under field conditions would undoubtedly be later than this.

QUARANTINE DIVISION.

Report for the Month of February, 1916.

By Frederick Maskew.

SAN FRANCISCO STATION.

Steamship and baggage inspection—

Ships inspected	71
Passengers arriving from fruit fly ports	2,249

Horticultural imports—

	Parcels.
Passed as free from pests	159,454
Fumigated	904
Refused admittance	106
Contraband destroyed	40
Total parcels horticultural imports for the month	160,504

Pests Intercepted.

From China—

Chionaspis citri, Chrysomphalus sp., *Pseudaonidia trilobitiformis, Lepidosaphes gloverii, Parlatoria pergandii, Parlatoria ziziphus,* and fungus on pomeloes.
Fungus on oranges.

From Florida—

Phomopsis citri, Lepidosaphes beckii and *Parlatoria* sp. on grapefruit.

From Hawaii—

Pseudococcus bromeliæ and *Diaspis bromeliæ* on pineapples.
Coccus longulus on betel leaves.
Hemichionaspis minor and *Chrysomphalus aonidum* on cocoanuts.
Pseudococcus sp., *Parlatoria* sp., and *Lepidosaphes* sp. on croton cuttings.
Pseudaonidia sp. on Hibiscus cuttings.

From Holland—

Lepidosaphes ulmi on boxwood.

From Japan—

Eggs of *Cicada* sp. on persimmons.
Phomopsis citri on Japanese oranges.
Pseudococcus sp. on wistaria.
Antonina crawi and *Leucaspis bambusæ* on bamboo.
Aleyrodes sp. on gardenia.
Larvæ of weevil in chestnuts.
Fungus on cherry.
Fungus on maple.
Larvæ of weevil in sweet potatoes.
Pseudococcus sp. and Lepidopterous larvæ on azaleas.
Pseudococcus sp. on Taomaba.
Fungus on lemon tree.

From Mexico—

Lepidosaphes gloverii on limes.
Larvæ of weevil in tamarinds.

From Tahiti—

Pseudococcus nipæ on cocoanut plants.

LOS ANGELES STATION.

Ships inspected	34

Horticultural imports—

	Parcels.
Passed as free from pests	74,257¾
Fumigated	7
Refused admittance	58
Contraband destroyed	18
Total parcels horticultural imports for the month	74,340¾

Pests Intercepted.

From Central America—
Aspidiotus cyanophylli and *Pseudococcus* sp. on bananas.

From Colorado—
Phomopsis citri and *Lepidosaphes beckii* on grapefruit.

From Cuba—
Pseudococcus sp. on tomatoes.

From Illinois—
Aleyrodes citri and *Chrysomphalus aonidum* on citrus.
Aleyrodes citri on citrus plant.

From Mexico—
Chrysomphalus aonidum and *Chrysomphalus aurantii* on rose cuttings.
Parlatoria pergandii and *Parlatoria* sp. on ornamental tree cuttings.
Chrysomphalus sp. on cocoanut.

From New York—
Aspidiotus perniciosus on lilac bush.

From Ohio—
Aleyrodes citri on Cape jessamine.

From Oregon—
Root knot and hairy root on apple tree.

From Texas—
Parlatoria pergandii on grapefruit.

From Utah—
Phomopsis citri and *Lepidosaphes beckii* on grapefruit.

From Washington, D. C.
Phomopsis citri, Leptothyrium pomi and *Lepidosaphes beckii* on grapefruit.

SAN DIEGO STATION.

Steamship and baggage inspection—

Ships inspected	30
Fish boats inspected	20
Passengers arriving from fruit fly ports	126

Horticultural imports—

	Parcels.
Passed as free from pests	3,357¼
Fumigated	2
Refused admittance	14¾
Contraband destroyed	5
Total parcels horticultural imports for the month	3,379

Pests Intercepted.

From Chile—
Unidentified larvæ in potatoes (very destructive).

From Florida—
Lepidosaphes sp. and *Chrysomphalus* sp. on grapefruit.

From Maryland—
Root knot on *Lonicera* sp.

From Mexico—
Lepidosaphes sp. and *Chrysomphalus* sp. on lemons.

From Missouri—
Larvæ of borers in peach stock.

From New York—
Crown gall on deciduous stock.

From Ohio—
Aleyrodes sps. on ornamental plants.

From Oregon—
Crown gall on deciduous stock.

From Texas—
Crown gall on deciduous stock.

EUREKA STATION.

Steamship and baggage inspection—
Ships inspected ---------- 2

Horticultural imports—

	Parcels.
Passed as free from pests	162
Fumigated	5
Refused admittance	1
Total parcels horticultural imports for the month	168

Pests Intercepted.

From France—
Monarthropalpus buxi on boxwood.

SANTA BARBARA STATION.

No report.

THE MONTHLY BULLETIN.

CALIFORNIA STATE COMMISSION OF HORTICULTURE

Vol. V. May, 1916. No. 5

OUR PRESENT KNOWLEDGE OF CITRUS FERTILIZATION.*

By H. J. WEBBER, Director of the Citrus Experiment Station, University of California, Riverside, Cal.

In continuing this discussion I can not do better probably than to summarize shortly our present knowledge of the methods of fertilization in order to get the question before you in its entirety.

The citrus grower in determining the best method of fertilization to use in his grove is confronted by a maze of contradicting so-called facts and theories. It is at present impossible to decide on any particular system of fertilization that can be said to be the best or that can even be recommended unhesitatingly as good. The whole subject is being investigated through the combined efforts of growers and the scientists of the College of Agriculture and of the United States Department of Agriculture. Information is accumulating, from which in a few years a more rational method of fertilization of citrus orchards can undoubtedly be formulated. In the mean time orchards must continue to be fertilized. Can any suggestions of value be derived from the various experiments at the present time? The following disconnected comments on the results of various experiments may be of some value as throwing light on certain problems:

The factor that seems to stand out most prominently in various experiments and in the experience of good growers is the great importance of adding organic matter to the soil. The great majority of our desert soils are apparently lacking in humus. The most satisfactory methods of increasing the organic matter in the soil is apparently through the growth of leguminous cover crops, such as bitter clover (*Melilotus indica*) and purple vetch (*Vicia atropurpurea*), and by the use of such materials for fertilizers as stable manure, alfalfa hay, bean straw, and the like. Our understanding of the reasons for this beneficial action of organic matter is as yet very imperfect. Organic matter is known to open up the soil, render it lighter, and better the tilth. Such soils are more porous and take the irrigation water better, and do not seem so prone to form a plow sole. An abundance of organic matter in the soil also favors the development of the bacterial flora of the soil that are known to be of such importance in breaking down and transforming the various manurial elements into forms soluble and available to the plant.

The evidence available regarding the use of cover crops points strongly to the greater value of using leguminous plants instead of cereals or other nonlegumes, primarily because the legume not only adds organic

*Address before the Special Citrus Convention, San Bernardino, Cal., February 19, 1916.

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matter but also nitrogen, and furthermore, because the experience in growing legumes in orchards and with other crops indicates that there is no detrimental effect produced by associating these plants together.

Both Doctors Kelley and McBeth have emphasized the great importance of cover crops. When we have a good thing, we must continue to emphasize it. I find some people opposed to cover crops, and here and there one meets a grower who has failed to get a good crop with the Melilotus clover. It is our experience that wherever a man knows how to plant and use the Melilotus, he is very certain to get good results, and when a man comes to me and says, "It is impossible on my soil to grow a crop of Melilotus," I can not but feel that he has not used the right method and possibly that we might help him to find the correct one. Certainly, it is a fact that in the great majority of soils Melilotus can be grown very successfully.

It is true that Melilotus at the present time is not altogether what we want, although it is the best thing we have. We really want something better than Melilotus, and this is one problem for the plant breeder. Melilotus is slow growing in the fall and winter, and it is only when the spring opens that it makes a good rapid growth. It may be possible, and probably will be, for us to breed a type of this clover that will grow more rapidly in the early winter season, thus producing a considerable crop in the early part of the season. This would make it a very much better winter cover crop than it now is.

Aside from Melilotus clover, we have emphasized purple vetch to be very good, and you may see samples of it at the Orange Show in connection with our Station exhibit. We are not certain that purple vetch is superior, or even equal, to the bitter clover or Melilotus, but it is a rapid grower in the fall and early winter and gets ahead of the weeds. It is a cover crop that should be tried out very thoroughly here and there all over the State.

In considering the use of winter cover crops, we should remember a point brought out by Doctor McBeth in regard to their fixing and holding the nitrogen until the spring months come and the danger of leaching away is past. This is another of the fundamental reasons for using winter cover crops of this kind.

Of the various plant food elements that are usually applied as fertilizers, nitrogen in California soils is by far the most important. From what source the nitrogen should be taken at present would seem largely to be a question of economy only. The one exception to be made to this statement at present is in the use of nitrate of soda. The experiments at the Citrus Experiment Station that have been under way for nine years show clearly an accumulating injury from the continued use of this material. Plats fertilized with nitrate of soda for several years gave excellent results but later became badly mottled and began to fail. After nine years their condition has become serious, no fruit of any value being produced. It may be that the use of certain other materials along with the nitrate of soda would have retarded this injury, but in a region where the soils are practically all in some degree alkaline, it would not seem a wise policy to add continually still larger quantities of sodium. As nitrate of soda contains a dangerous element, its use in the fertilization of citrus trees in California should be discontinued, particularly as many other sources of nitrogen are available at as reasonable a cost, such as dried blood, tankage, sulphate of ammonia, and

nitrate of lime, and no question of injury from the use of these has yet been raised.

A factor of great practical importance is found in the possibility of using such home grown products as alfalfa hay, bean straw, and the like. These materials are rich in nitrogen, and in using them the grower is also adding large quantities of organic matter as well as small quantities of phosphorus, potash, and other desirable elements in about the proportion usually needed by plants. When such materials can be obtained at a fairly reasonable price, the value of the nitrogen in them alone would justify their use. As an illustration, alfalfa hay, air-dried, usually contains about 2.25 per cent of nitrogen, so that at $8.00 per ton one would pay but $3.55 per unit of nitrogen, which is much cheaper than it can be obtained from most sources. The same is also true of bean straw.

Now, you may ask as to the availability of alfalfa hay when used as a manure. What I can say regarding this, I take entirely second-hand from Doctors Kelley and McBeth, but nevertheless they will pardon me. I understand from these gentlemen that when hay of this kind is plowed under it becomes available very quickly, beginning to be available ordinarily within two or three weeks after the time of plowing under, and certain it is that it becomes available very shortly, as is shown by the increased growth of weeds and cover crops.

No special statement need be made regarding the use of all stable manure available. There is apparently no better material to use in an orange grove in California. Those of us who have come from Florida would question the advisability of using stable manure because in Florida stable manure produces die-back, and we have seen it thrown away rather than made use of on an orange grove. However, when it comes to California, we know by long experience that the best trees are produced near the stables, and apparently we can not get too much stable manure to give good results. It goes without saying here, so far as stable manure is concerned, that there is nothing better. The only difficulty is that there is not enough produced to serve our purposes.

The general use of home-produced materials, such as the above, will add greatly to the wealth of California products, and where they give equally good results their use is certainly to be encouraged. Doubtless millions of dollars have been expended for imported materials that might more profitably have been expended for home products and have assisted in building up our own industries.

Phosphoric acid, which is a principal ingredient in all of our fertilizers, has in some experiments given indication of increasing the yields slightly, but its importance is not so clearly evident as that of nitrogen. It would seem, however, that the application of some phosphorus will prove of practical value. The comparative value of raw rock phosphate and superphosphate has not yet been fully determined.

In times past large quantities of potash have been used in fertilizing orange groves, the sulphate of potash being almost universally used. In the experiments at the Citrus Experiment Station three plats treated with potash for nine years have given an average yield little, if any, larger than three similar plats to which no fertilizer was added. The indications at present are that the addition of potash as a fertilizer is of doubtful value.

CERTIFIED—SIGNED—SEALED.

By Frederick Maskew.

As a result of their direful, almost calamitous, experience in attempting to control the cottony-cushion and San Jose scales, the crop producers of California became convinced that protection from further invasions of a similar nature depended solely on the control and careful inspection of all importations of plants and plant products at the point of delivery. Fortunately, they also became wide-awake in time to the important fact that personal attempts to introduce an occasional so-called acquisition to our flora constituted as great, if not a greater, danger of introducing new and dangerous insects—as proven by the two cases cited above—than did the commercial shipments of standard nursery stock; that exceptions to the rule would ultimately bring their best efforts to naught and that all imports of plants should be subject to the same supervision, if complete control is to be maintained. So firmly fixed in this State is the common belief in this policy that from its inception, steadfastly, consistently, at all times, against all objections and at great expense the system has been adhered to, developed and extended until the mail, the last open avenue of unrestricted entrance for plants and pests—the former *bête noire* of the diligent quarantine officer—has been subjected to control and the circuit of protection completed.

Fig. 57.—A gardenia plant infested with live *Dialeurodes citri*, the citrus white fly. (Photo by L. A. Whitney.)

The above illustration corroborates our long contention that the mail furnished a facile entrance into California for insect pests of our orchard trees. The cut portrays a gardenia plant shipped by Wachendorff Bros., florists, Atlanta, Georgia, to Mrs. J. L. Hunter, Orange, California, through the medium of the parcel post. Under the new post office regulations this plant was delivered to the horticultural quarantine inspectors for examination, declared infested beyond treatment and eventually sent to the Central Quarantine Station by Mr. Roy K.

Bishop, the State Quarantine Guardian of Orange County, California, for determination of the Aleyrodes infesting its foliage and for final destruction. There were 108 leaves on this gardenia plant. Twenty-nine leaves taken at random were found by actual count to be carrying 1,282 larvæ of *Dialeurodes citri*, an average of 44 to the leaf. This plant infested with these citrus white flies was shipped to and delivered at a point in the very heart of California's citrus industry. The consignee is the owner of an orange grove, and the plant, had it not been for the present postal regulations and the diligence of the horticultural inspectors, would in all probability have been planted in the consignee's yard immediately adjoining the orange grove. It would be superfluous to comment on Mr. Bishop's terse statement: "I am wondering what would have ultimately happened had the plant been set out in the yard." The citrus white fly is a winged insect; the city of Orange is contiguous to many square miles planted to citrus trees, and seriously considering all the potential factors of the situation the county of Orange was remunerated in this instance for all the money it has expended in maintaining an inspection of imports of plant products seeking an entrance into its territory.

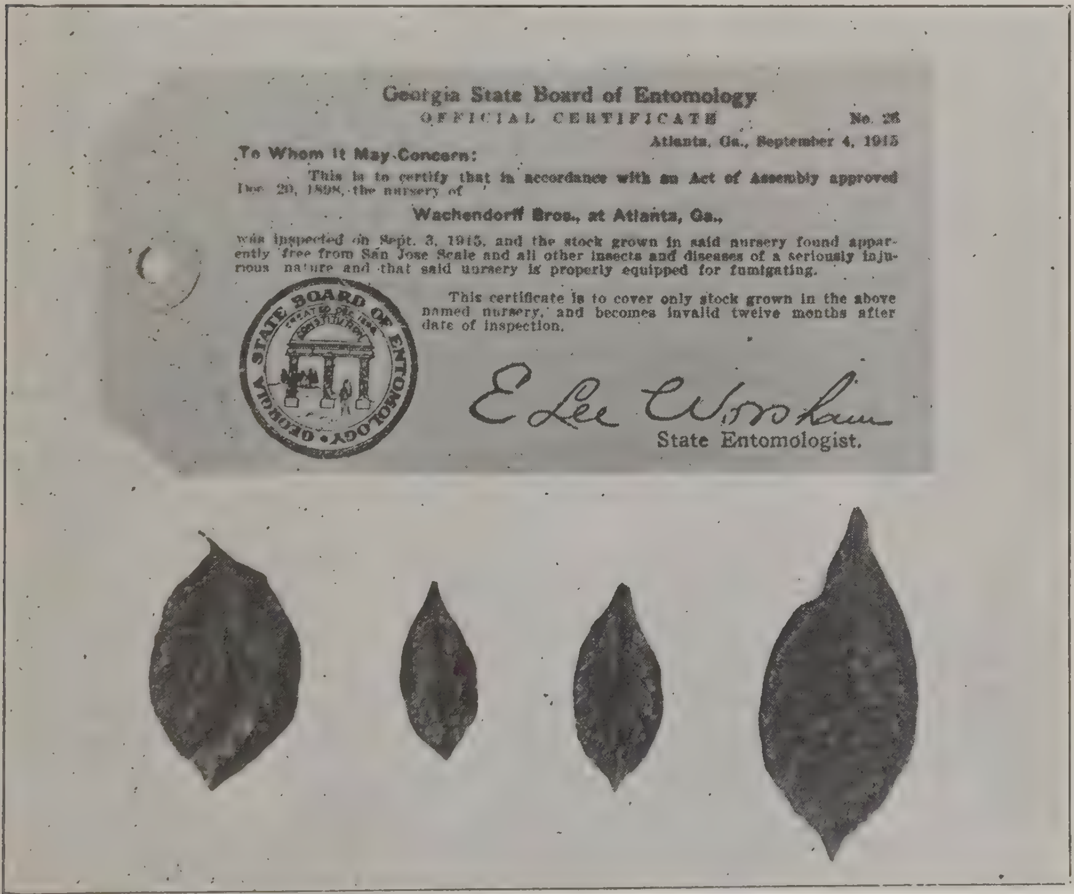


FIG. 58.—An official certificate of inspection found attached to a gardenia plant. Leaves taken from the same plant showing infestation of live *Dialeurodes citri*. (Photo by L. A. Whitney.)

This illustration is so graphic as to dispense with the need of descriptive text. It is simply another unit to the thousands of items in our records proving the unreliability of such certificates as representing a statement of known facts. To us the sole value of certificates issued

under such a system consists in apprising the inspector of the point from which the material was shipped. Experience has taught us never to accept them as passports. The blame in such instances as the present one should not lay upon the official who signed and issued the certificate, but upon the system which obliged him to so do. The certificate in question is beyond doubt but one of hundreds similar in nature placed in the possession of the nurseryman by the operation of the system, and which permits the unscrupulous dealer to attach the same to plants the inspector never even saw.

Exception may be taken to the foregoing that under the regulations in force at point of origin the infested plant in question did not come under the classification of nursery stock, but such a distinction is not a general safeguard, and just so long as such a system is in vogue and permits the attachment of certificates of inspection to infested plants, Californians should adhere more firmly than ever to the principle established in this State of inspecting all imported plants and plant products at point of delivery.

A PROMISING NEW PEAR STOCK.

By F. C. Reimer, Superintendent, Southern Oregon Experiment Station, Talent, Oregon.

In the Monthly Bulletin of the California State Commission of Horticulture for July, 1915, appeared an article on "Blight-Resistant Pear Stocks," written by Mr. George Compere. This article was prompted by an article written by myself and published in the Monthly Bulletin for March, 1915. In my article I recorded the fact that the Southern Oregon Experiment Station was doing extensive work on the problem of blight resistance, and that the Chinese sand pear, *Pyrus sinensis,* had shown far greater resistance to blight than the French pear, *Pyrus communis.* In his article Mr. Compere records the fact that while he was collecting useful insects in China in 1908, he was impressed with the healthy appearance and vigor of the wild pear trees even under very trying conditions. He collected seeds of this wild pear which were sent to California, and some of these were planted by Mr. B. B. Whitney at Oroville, California, and the trees which resulted from this planting have shown no signs of pear blight and have been remarkably free from the woolly aphis.

I wish to record the fact that when Mr. Compere sent these seeds he performed a far greater service to Pacific coast horticulture than his article indicates, or than he has probably realized heretofore. The Chinese sand pear, commonly known as *Pyrus sinensis,* was introduced into the United States many years ago, and has been known to horticulturists in this country for at least seventy years. Hence, if Mr. Compere had sent seeds of the Chinese sand pear to this country on that occasion, it would be a matter of strictly secondary importance. This, however, is not the case.

Mr. Compere's article, fortunately, was illustrated. One of these illustrations convinced me that this pear was not the Chinese sand pear. For this reason I had leaves and immature fruit from these

trees sent to me, and later, while in California, I made a careful examination of these trees, which at once showed that this species was very distinct from the Chinese sand pear. For this reason I collected fruit, leaves and branches which I took with me while on an extensive trip through the eastern states investigating pears. During this trip I made an exhaustive study of the splendid collection of wild Chinese pears in the herbarium of the Arnold arboretum. I found that the specimens which I had collected at Oroville corresponded very closely with herbarium specimens labelled *Pyrus calleryana,* Decaisne, which had been collected and identified by Dr. C. S. Sargent while at the Botanic Garden, Hongkong, China, in 1903. *Pyrus calleryana* was described in 1872 by J. Decaisne, the French pomologist, in his "*Le Jardin Fruitier du Museum,*" from herbarium material collected in China by Callery. Hence this pear could be very appropriately designated the Callery pear.

Pyrus calleryana is very widely distributed in China, and, consequently, varies considerably, especially in leaf characters. For example, one type from southeastern China, to which the Oroville trees belong, possesses leaves with a strongly wedge-shaped base. C. K. Schneider, the Austrian botanist, studied material of this form, and in 1906 designated it as *Pyrus koehnei* in his book "*Illustriertes Handbuch der Laubholzkunde.*" I do not believe that this form differs sufficiently from *Pyrus calleryana* to be designated as a distinct species. Schneider, himself, is not at all certain that this form should be separated from *Pyrus calleryana.* For instance, in speaking of this and other species of Pyrus in "*Repertorium novarum specierum*" for October 15, 1906, he states "Perhaps *koehnei, kolupana,* and *calleryana* are only geographical varieties of one species." Mr. E. H. Wilson, of the Arnold arboretum, who has spent many years collecting plants in China, and who has given special attention to the wild species of Chinese pears, told me in a personal interview that he regarded *Pyrus koehnei* as a form of *Pyrus calleryana.*

After a careful study of these two types I have concluded that the type at Oroville, California, is simply a form of *Pyrus calleryana.*

PYRUS CALLERYANA AND PYRUS SINENSIS.

Recent studies of the group, *Pyrus sinensis,* show that what has commonly been considered as *Pyrus sinensis,* Lindl., is in reality a group of several closely related species. This group of species, however, is very distinct from *Pyrus calleryana* and its related forms, the difference being especially marked in the leaf characters. The leaves of the Chinese sand pear, commonly grown by nurserymen, are long, comparatively narrow, with a truncate or rounded base, and with sharply toothed or bristle-like margins. The leaves of *Pyrus calleryana* are short, comparatively broad, with a rounded or broad, wedge-shaped base, and with the teeth on the margins markedly rounded or crenate. The leaves are generally very glossy and shiny. The fruit is small, about the size of a large garden pea, brownish, and with a deciduous calyx.

Pyrus calleryana usually has three or four pistils, rarely two or five. *Pyrus sinensis* usually contains five pistils, rarely three or four.

The difference between the leaves of the two species, especially the form and the nature of the leaf margins, is so noticeable that two species

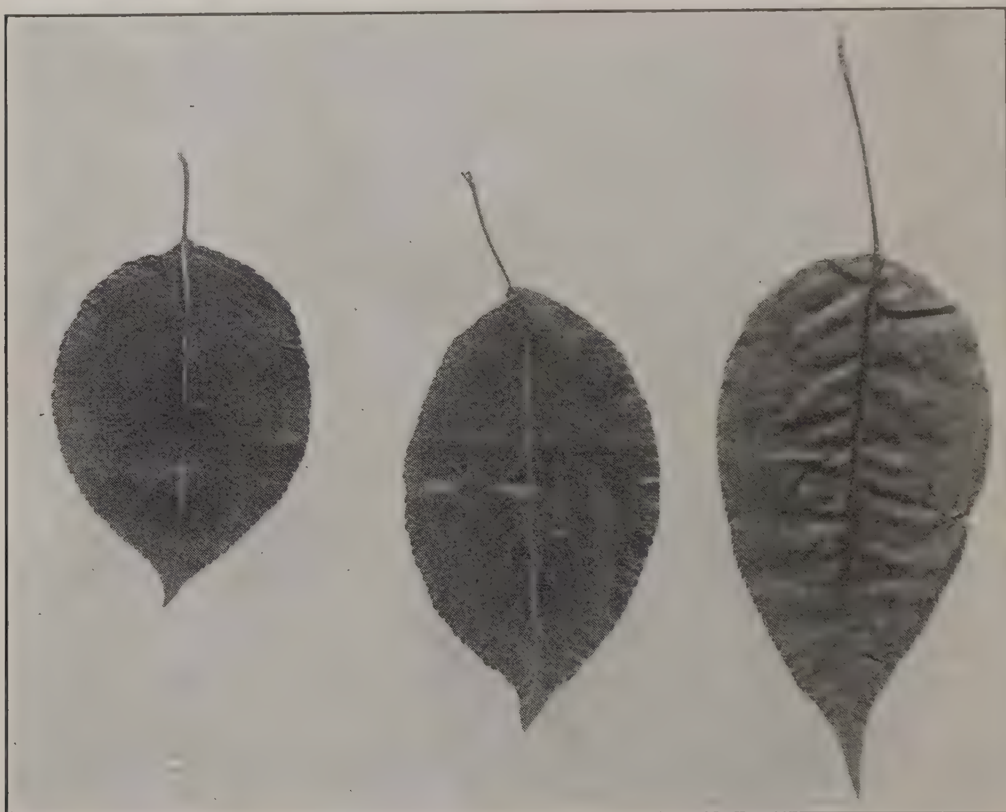


FIG. 59.—Leaves of two species of Pyrus. The long slender leaf with sharp serrations is *Pyrus sinensis*. The other two are types of *Pyrus calleryana*. The one in the center is from a tree at Oroville, Cal. About one-half natural size. (Original.)

never need be confused. Even in the nursery row any nurseryman can readily distinguish them.

BLIGHT RESISTANCE.

Mr. Compere in his article called attention to the fact that the trees at Oroville had never shown any signs of blight. During the past winter the writer carried on inoculation experiments on three-year old trees of the type from Oroville and other forms of *Pyrus calleryana* in the greenhouse. These inoculations have shown that this species, while not absolutely immune to pear blight, is very resistant to this disease. While the disease developed in the one-year old branches, it would never progress into the two and three-year old wood. Inoculations made on the tips of vigorous growing shoots produced the disease readily, and on several branches it extended down these young slender shoots for a distance of from two to three feet. As soon as the disease reached the older, harder wood it would stop. In no case did it develop in branches more than one-half inch in diameter. The three-year old trunk of one tree of the Oroville type has been thoroughly inoculated at various times without producing the disease. For example, the

FIG. 60.—Twig of *Pyrus calleryana* from Oroville, California, showing ripe fruit This is an extremely prolific species and hence will produce large quantities of seeds for seedlings. Natural size. (Original.)

trunk was inoculated with pear blight in twenty-five places on three different dates. This same tree has been inoculated at forty points on the tap-root and main branch roots on four different occasions. These inoculations have never developed the slightest trace of the disease. Check trees of Bartlett, Forelle, *Pyrus pashia*, and French pear seedling, inoculated on the same dates, with the same lots of bacteria, developed the disease readily, and part of them are already dead.

A two-year old tree of another type of *Pyrus calleryana* has been repeatedly inoculated in the tips of tender, vigorous shoots and on the trunk, but it has never shown a trace of the disease on the trunk. The inoculations on the young tender shoots developed the disease readily, which extended down these shoots until it reached the hard one-year old wood, where it stopped.

Whether the seedlings from the trees at Oroville will show this same degree of resistance remains to be determined. If the blossoms are not cross-fertilized with pollen from some other species, these seedlings will undoubtedly show as great resistance as the parent trees. We have a large number of seedlings of this species growing at this station, and as soon as the trees are large enough inoculation experiments will be started.

HABITAT.

Pyrus calleryana is a widely distributed species in China, and is found in the southern, eastern, central, and western parts. It grows at elevations of from a few feet above sea level to a height of 5,000 feet, being especially abundant at elevations of from 3,000 to 5,000 feet.

The Oroville type of this species is especially abundant in southeastern and eastern China. Mr. Compere found it abundant along the rivers and in the swamps between Hongkong and Canton, sometimes growing vigorously under the most adverse conditions. Since the type at Oroville came from near Hongkong, which has a tropical climate, it is possible that it will not prove hardy in cold climates. This, however, is not necessarily true, but it should be tested in cold regions before it is extensively planted. The trees are perfectly hardy at Oroville, California, and appear to be hardy in southwestern Oregon. *Pyrus calleryana*, collected in central China, is hardy at Boston, Massachusetts.

VALUE AS A STOCK FOR OUR CULTIVATED VARIETIES.

This species, so far as I can ascertain, has not been thoroughly tested as a stock for our cultivated varieties of pears. There is nothing to indicate that it will prove unsatisfactory.

This station has a two-year old tree of *Pyrus calleryana*, which was grafted on the common French seedling, *Pyrus communis*, and this is growing especially well on this stock. We also have the Oroville type and other types of this species growing on some of the common varieties of *Pyrus communis* and also on the Chinese sand pear. In all cases they appear to make a satisfactory union. As soon as our seedlings of *Pyrus calleryana* have reached the proper size, a large number of them will be budded with Bartlett and other varieties.

Since *Pyrus calleryana* has shown very marked resistance to pear blight, and, as it is widely distributed in China, has been found growing on a great diversity of soils, and is extremely vigorous, it may prove very valuable as a stock for our cultivated varieties of pears. Also, since the type found at Oroville appears to be perfectly at home in the swamps of China, it ought to prove valuable on wet soils, especially on soils along rivers such as those of the great pear region along the Sacramento River, California. This type also appears at home on dry soils. At Oroville the trees are growing splendidly on high, dry soil where the drainage is perfect at all seasons of the year.

The trees at Oroville now belong to Mrs. Leonora Williams, 1334 Danielson avenue, through whose courtesy our material of this type was obtained.

The other forms of *Pyrus calleryana* were obtained through the kindness of Dr. C. S. Sargent, Director of the Arnold arboretum, Jamaica Plain, Massachusetts. These forms of this species were collected in central China and introduced into this country in 1908 by Mr. E. H. Wilson of the Arnold arboretum. It is of interest to note that Mr. Compere and Mr. Wilson introduced these types of the same species during the same year, although collected in very widely separated localities of China.

CONCLUSIONS.

In conclusion I must state that the Southern Oregon Experiment Station has perhaps the largest collection of species of Pyrus in the world. In our inoculation experiments most of these have proved quite susceptible to pear blight, while a few have shown marked resistance. As I have already called attention to these species in another report,* it is not necessary to discuss them here. I wish to state, however, that we have not found a single species up to the present time, even of the most blight resistant, which is absolutely immune to the disease. In all cases we have been able to produce the disease in the young, vigorous, growing shoots. However, we have at least three species in which we have never been able to produce the disease in wood more than one year old. It should also be noted that all of the resistant species found up to the present time have come from China, except one from northern India.

It is probable that for very cold regions some of the blight resistant forms of the Chinese sand pear, such as the Japan pear seedlings, and others of this type, will prove most desirable as stocks. For the warmer regions *Pyrus calleryana* and its various sub-types appear very promising and should be thoroughly tested.

Throughout this article the term pear blight has been used to designate the disease commonly known to American horticulturists as pear blight and scientifically known as *Bacillus amylovorus* (Bur.) De Toni.

*Proceedings of the American Pomological Society, Thirty-fourth Biennial Session.

SOAPS AND MISCIBLE OILS.

By E. RALPH DE ONG,* Entomologist, University of California Farm School, Davis, California.

The use of soap for insecticidal purposes received its first official recognition in 1840. For many years soap was a popular remedy for plant lice and has been used against the cottony-cushion and other scale insects, especially in their immature stages. In 1885 extensive experiments with soaps were begun by Coquillett and continued the following years by Albert Koebele, in an attempt to control the cottony-cushion scale (*Icerya purchasi*), and the red scale (*Aspidiotus aurantii*), which were then sweeping over southern California. In the published report[1] of this work we have a very complete record of formulæ for insecticidal soaps of that time and but slight improvement has been made since, for soon afterwards oil emulsions, together with tobacco extracts, supplanted soap to a large extent as a spray in field work; but for the garden and small orchard fish oil soap still holds a place. To meet the demand for a soap that would be more readily soluble in water than the ordinary soap of commerce, several liquid soaps have been put on the market. These differ from the hard soap, chiefly in the water content, this being from 50 to 70 per cent, while a good hard fish oil soap will contain 20 to 30 per cent of water. Liquid soaps when well made mix readily with water, making a very easily prepared spray.

Aside from the use of soap for its insecticidal value its chief use now is in connection with other spray materials. Nearly all of our home-made oil emulsions are based upon fish oil soap as the emulsifying agent.[2] Tobacco extract, the second great rival of soap as an insecticide, is more satisfactory when used with soap, as spray solutions made from tobacco alone have a tendency to gather in drops on the leaves, but spreads much better when used with soap at the rate of 4-8 pounds to 200 gallons of spray, depending on the hardness of the water.

WATER SOFTENING.

When it is necessary to use hard water in making emulsions, and the common methods of softening water have failed, the use of fish oil soap at the rate of one to three pounds of soap to 50 gallons of water in addition to the soap used for other purposes, has given good satisfaction. The soap when dissolved unites with the lime, magnesia and many other salts found in water, to form an insoluble soap, thus removing many elements that would have a tendency to break down the emulsion.

SOAP MATERIALS.

The fish oil soap of commerce—or whale oil soap as it is frequently termed—is generally made of fish oil or "Menhaden oil," the latter being applied to a certain grade of fish oil obtained largely on the

*I am indebted to Mr. George P. Gray, of the University of California, for chemical advice in my work on soaps.

[1]U. S. Dept. of Agriculture Report for 1886.

[2]Mr. E. L. Morris, County Horticultural Commissioner of Santa Clara County, recommends the use of rosin laundry soap as a cheaper emulsifier than whale oil soap.

eastern coast. Very little genuine whale oil is now used in soap making. The principal sources of our fish oil are the waste from fish canneries and fertilizer factories, the oil being pressed out of the cooked fish, then heated to drive off the water and purified, if a high grade oil is desired. Fish oil generally sells at 26 to 30 cents a gallon wholesale.

Tallow or any waste fat may be substituted wholly or in part for oil. This makes a harder soap than oil but is not considered as valuable for insecticidal purposes.

Rosin has the same properties as the fats of uniting with alkalies to form a soluble soap, which is darker in color but lathers more freely and is supposed to have good penetrating qualities. By reason of the cheapness of rosin its use will decrease the cost of the soap materially, and if desired it may be substituted up to one-third or more of the oil or fat used. Rosin soap is considered more active as an insecticide, but should be used with care on delicate plants.

Insecticidal soaps are usually soft soaps, but may vary in consistency from a hard cake slowly soluble in cold water to a liquid which dissolves almost instantly. It is possible to make soft soaps from soda but potash is most frequently employed. By the latter method the waste lye and other impurities are retained in the soap, making it more caustic. If soda is used, a caustic liquid containing waste lye and crude glycerine settles to the bottom, the soap rising to the surface. For this reason the soda soap is harder and less alkaline, as it has been largely freed from the waste alkali and glycerine. Besides, the potash soaps absorb water while the soda soap gives off moisture when exposed to the air, as is shown by the salts crystallizing on the surface of the soap.

The caustic form of potash or soda is generally used in soap-making, although the carbonate form may be used by boiling longer. During the process of boiling the alkali combines with the oil or fat to form soap, or "saponifies" the fat, as it is called. By the action of the alkali on the oil the latter is broken down into a fatty acid and glycerine, the acid combining with the alkali, the glycerine being a waste product. Caustic soda may be readily obtained in the form of "concentrated lye," but this, if exposed to the air, will absorb enough water to dissolve itself, being partially converted into the less caustic carbonate form, as will also caustic potash, hence these chemicals should be left in the original package until ready to use. Potash is not as easy to obtain as soda and is more expensive; much of the so-called potash lye is mostly soda and is unsuited for making soft soaps. Laundry supply houses generally carry good grades of crude caustic potash, which retails in small amounts for eight or ten cents a pound. Potash will not saponify as much oil or fat as soda, the proportion being about five to seven.

It is possible to substitute soda for potash up to one-fourth or one-fifth the amount of alkali, but this should only be attempted after careful experimenting.

Hard water used in soap making has the same effect as when making up a spray solution or soap suds; the lime and magnesia salts present in the water break down the soluble potash soap and form an insoluble

*Florida Report for 1911-12.

lime soap that floats on the surface of the water as a sticky, greasy mass. In soap making this insoluble matter mixes with the soluble part, making a poor grade of soap.

Hardness of water may be either "temporary" or permanent. The former is generally applied to the presence of bicarbonate of lime in solution in the water, while "permanent" hardness is due to the presence of mineral salts in the water, which can not be removed by boiling or a simple chemical treatment.

Boiling the water will overcome temporary hardness as will also the addition of quick lime (calcium oxide). By either method the soluble bicarbonate is converted into the normal carbonate, which is insoluble. The insoluble lime settles out and the clear water may be poured off.

The permanent hardness of water is not affected by boiling but must be treated with some chemical that will unite with the minerals held in solution in the water, and cause them to settle out; afterwards the clear water may be poured off. The ordinary lye of commerce, or lime, may be used, but with lime it is believed that a slightly soluble salt (calcium hydroxide) is formed, which would also give trouble. Carbonate of soda (sal soda) is preferable, as this forms an insoluble salt that is precipitated out; but even this form would be of no avail in the treatment of alkali water. Soda ash phosphate may give better satisfaction than sal soda (carbonate of soda) as it will dissolve in water much quicker than the carbonate form.

If there is any doubt as to the quality of the water used it is best to have a chemical determination made as a guide to further work.

MANUFACTURE OF SOAP.

Soap making is an art rather than a science, and proficiency comes only through long practice. Soft soap is considered easier to make than the hard, but even with this form the varying factors of water, oil and alkali are often difficult to adjust. On a large scale steam may be used, but as the cooking period is not long and a very high temperature is unnecessary except in cresol mixtures, elaborate preparation is unnecessary.

Fish Oil Soap.

FORMULA.

Fish oil	3 gallons
Caustic potash	4 pounds
Water	8 gallons

This soap, used at the rate of one pound to eight gallons of water, gives good results against aphids (plant lice). Use a large kettle that will allow for frothing during the boiling. In this dissolve the caustic potash in hot water, then add the oil and boil until the soap is formed, which is shown by a light brown color. This stage is usually reached within a few minutes. The mixture should now be somewhat stringy when dipped up with the paddle; dropped into cold water a clear solution with no globules of oil floating on the surface results. A little of the melted soap may be dropped on a clean piece of glass and allowed to harden; when cold it should be almost clear, with no free oil or grease. After this stage has been reached it simply remains to boil the soap down to the proper consistency. If there is any free oil after the soap is formed a little more alkali dissolved in water should be

added (a slight excess of alkali is better than to have free oil). Too much alkali will give a frothy appearance to the soap in cooking; to overcome this more oil may be added and the cooking continued a short time. If a dark brown liquid settles out during the cooking with a layer of soap floating on the surface, the alkali used was largely soda and a hard soap has resulted. A little soap left in the kettle will assist the saponifying action of the next soap making.

MISCIBLE OILS.

Oil and water are very incompatible and, in order that a uniform mixture or emulsion may be made, a third substance must be employed, such as soap, which will dissolve in oil and in this way prepare the two for mixing. Ordinary soap is but slightly soluble in petroleum oils, but the presence of cresylic acid adds very greatly to the solubility of the soap in oil, so that cresylic acid, in the form of cresol soap, has become one of the most important emulsifiers of petroleum oils.

The chief use of cresol soap is in making miscible oils, or for making petroleum oil emulsions, instead of by means of fish oil soap or other emulsifiers. The commercial form of cresolated oil emulsions may contain 85 to 90 per cent petroleum oil, while other forms of commercial oil emulsions generally contain about 60 per cent of petroleum oils.

Cresol Soap.

FORMULA.

Fish oil	1 gallon	Heat to 290 or 300 degrees Fahrenheit and then add kerosene and water.
Cresylic acid	1.5 gallon	
Caustic soda	0.5 pound	
Kerosene	3 gallons	
Water	2 gallons	

(Petroleum oil, either kerosene or distillate or crude oil, to be added to the above soap when spray solution is wanted.)

Place the soda and the oil in the kettle and heat until the alkali is dissolved; if desired a little water may be used for dissolving the potash, then add the cresylic acid[1] and heat the mixture to 290 or 300 degrees Fahrenheit. When this point is reached the boiling slakens and a quantity of very heavy dark fumes is given off; the mixture should now be removed from the fire; while still warm—but at a distance from the fire—add the kerosene and *afterwards* add two gallons of water. If this is added before the kerosene an explosion may result.

Liquid cresol soap may be kept indefinitely without breaking down, but not after making into a miscible oil. The soap is mixed cold with distillate or crude oil; the volume of oil used can only be determined by experiment, but will probably vary from five to ten times the volume of soap. This combination of soap and oil is called a miscible oil, and upon the addition of water should give a good emulsion with no free oil. If free oil is present an insufficient quantity of soap was used or else the preparation was not mixed well. The soap and oil may be combined at any time to form the miscible oil, but if the latter stands after the mixing it should be stirred well before being used for making emulsions. When water is added to the miscible oil it should be done

[1]Delaware Bul. No. 75. In this bulletin several formulæ are given for cresol emulsifiers, but instead of cresylic acid, the grade of carbolic acid known as "straw color," 100 per cent pure, is recommended.

very slowly at first and with strong agitation to insure a thorough mixture of oil and water. The proportions for spray mixtures may be calculated from the total amount of oil in the miscible form. If the cresol soap is dissolved in six times its volume of oil the resulting mixture contains 93.4 per cent of oil to make a 7 per cent oil emulsion 7.5 gallons of the miscible oil would be added to 92.5 gallons of water.

The first combination of cresylic acid, fish oil and soda is the real soap or emulsifier, as it is spoken of in eastern literature, the kerosene and water being added to prevent it from hardening. At this stage it is a very dark colored liquid which forms a beautiful emulsion by the addition of water. It may be used as a disinfectant for poultry houses, but is too strong and besides too expensive for spraying plants or trees.

Miscible oils are the ideal form for making emulsions and merit more attention from the manufacturer and the user than they have received. If well made they are as permanent in structure as the commercial emulsions, if not more so, containing all the active ingredients of the latter, their only difference being in the amount of water contained. They make as good a spray as emulsions made in any other way, if not a better, require less storage space with a corresponding saving in freight, and place in the hands of the user a concentrated article, convenient to handle, less liable to revert with long standing, and ready at an instant's notice for use. The emulsions from miscible oils are, however, more expensive than some of the other emulsions, and in some eastern publications are reported as more dangerous to foliage and even to dormant trees than those made with soap or mechanical mixtures.

LESSONS GATHERED FROM THE YEAR 1915.*

By C. C. Teague, General Manager, Limoneira Orchard Company, Santa Paula, California.

The year 1915 has gone on record as the most disastrous in the history of the lemon business, the California lemon crop having been marketed at a loss of approximately thirty cents per packed box to the grower. The bad results obtained were due to several causes.

The reduction of the protective tariff from one and one-half cents per pound to one-half cent per pound permitted the importation of heavy supplies of foreign lemons during the spring and early summer months in the face of the largest California crop that the State had ever produced. Competition thus forced prices to a ruinously low level in the early spring, and the summer following was the coldest known in history all over the United States. A heavy supply of stored fruit, much of which was aged and in bad condition, was forced on to the market when there was little demand. The result was an almost completely demoralized market condition.

Post-mortems are usually held, not for the benefit of the dead, but for the living. Adversity, tribulation and even death often result in

*Address before the Special Citrus Convention, February 19th, San Bernardino, California.

benefit to the living. Let us hope that the lemon business will, in the long run, benefit from the experiences of the past year.

Some of the benefits that I shall hope for are:

First. An increase in the protective tariff on lemons. Surely, it should be easy now to demonstrate that our industry should have a duty that will protect against our markets' being flooded with cheap, poor quality foreign lemons, produced by cheap labor, and shipped by cheap water transportation.

Second. The bad results of the past year will make the growers and packers scrutinize more carefully their cost sheets and endeavor in every way to lower these as much as possible, and, at the same time, increase the quality and quantity of their production.

Third. The excessive amount of decay reported in many cars on arrival in eastern markets and the object lessons of how this decay affects values will certainly cause growers and packers to bend every effort to seek the causes. Nothing detracts from good results in the lemon business so seriously as excessive decay, and the good or bad reputation of any brand and its ability to command the highest market price in any market depend largely on the record that that brand has made for good keeping quality.

Appreciating the importance of this, the California Fruit Growers' Exchange, through which is shipped eighty per cent of all of the lemons of the State, has permanently added to its force a field man, or supervisor of all of its lemon packing houses. Mr. G. W. Hosford, one of the ablest and most experienced lemon men of the State, has been employed in this capacity and is making regular rounds of the Exchange houses, studying the records of these houses and pointing out to the managers the weak places in their methods of picking, handling, grading and packing. To my mind this is one of the most important steps in advance taken by the Exchange within my knowledge. Hitherto the Exchange said to the local association, "We will take your fruit and market it to the best of our ability, leaving it entirely to your judgment as to how that fruit shall be handled and packed." The result of this naturally was that good association management got good results and bad management bad results, and the figures gotten by bad association management were used to discredit the Exchange system of marketing by those interested in so doing. This field department will undoubtedly result in greatly improving the quality of the pack from the Exchange houses. Even this early, improvement is noticeable in the standardization of grades and in less decay by reason of better handling and by the proper classification of green, light green, and ripe fruit at the washing machines, which means that much of the ripe fruit which has been allowed to be packed under extra choice and choice brands at the expense of good keeping quality, will not, in the future, be packed under those brands, but will be packed under ripe brands and sold on its merits.

Out of all of the grief of the past year, therefore, have come better business methods on the part of the grower, packer and seller, which are resulting, and will result more and more as time goes on, in placing in the markets of America a better California lemon, which undoubtedly is the best lemon that the world produces when it is handled properly, and when this fact is generally recognized among the jobbers,

retailers and consumers of the country, as it will speedily be through the Exchange system of national advertising, with a reasonable tariff there should be no difficulty as the California crop increases in gradually forcing the foreign lemon out of American markets, resulting in an American grown crop supplying an American market, which will be as it should be.

CULTIVATION AND COVER CROPS.*

By W. M. Mertz, Superintendent of Cultivations, Citrus Experiment Station, University of California, Riverside, California.

Cultivation, meaning the stirring of a soil to accomplish aeration and to prevent evaporation, is a practice which has been in vogue among agriculturists since the beginning of agriculture. Under the semiarid conditions of the southwest, cultivation has assumed a more important role than in most of the sections of this country. Water has, in reality, been the limiting factor with most of the cultivated land. Thus certain cultivation was necessary to conserve this valuable element. Investigations carried on some little time ago showed that cultivations to a depth of four to six inches materially lessened the evaporation of soil moisture and in this regard were much superior to shallow cultivation, such as is adapted to eastern humid conditions.

Cultivation, in that it aerates the soil, tends to increase the oxidation of organic material. The high temperatures met with during the summer months in this State also make for the increase in the oxidation process. Thus, in the conservation of water the excessive cultivation has caused a considerable loss of organic material in many of our soils. In fact, there are many who believe that the loss of organic material by such frequent cultivation, is more serious than the loss of water caused by systems employing less frequent cultivations. As with all things, we usually find a happy medium, which is better than going to either extreme. Too frequent cultivation is extremely exhaustive of organic material; too infrequent is just as exhaustive of the irrigation water. The type of soil, the location and the crop will all have a bearing on the frequence and depth of cultivation. In the heavier types of soil, cultivations are usually more frequent while the lighter soils are frequently well protected from evaporation by a single cultivation after each irrigation.

As can readily be seen, cultivation and irrigation are two factors of our orchard management which are practically inseparable. Thus, on soils which require irrigation every three weeks, cultivations as frequent as this are demanded. On heavy clays irrigations are frequently made at as long intervals as every ten or twelve weeks. This interim is usually too long to expect one cultivation to maintain a reasonably efficient mulch. Again, the clay soils do not crumble and make as good a mulch in one cultivation as the sandier soils. It has seemed good practice on such heavy soils to cultivate two or three ways as soon as the land is in proper shape to work. Again, another cultivation or possibly two, is often advisable before the land is again irrigated

*Address before special apple meeting, San Bernardino, Cal., February 19, 1916.

This is done in order to break up the capillarity of the surface soil which gradually becomes established as the soil settles, even though it be dry. One of the most important items connected with the cultivation of irrigated land is that regarding the condition of the soil when cultivated. A soil containing any large proportion of clay can be puddled and put in bad physical condition by working it when too wet. Soils once worked in this condition will frequently require from one to two years to get them back to as good a physical condition as existed before this maltreatment.

One of our greatest troubles in this semiarid region, is due to the formation of an irrigation plow sole. This word is used advisedly, as it really is a combination of two terms, "irrigation hardpan" and "plow sole." Irrigation and cultivation are two very important factors in the formation of this compact layer of soil. Irrigation in furrows tends to stratify the soil, thus concentrating the finer clay particles in a layer which, when dry, becomes so hard as to be almost impervious to water. Under most of our cultivation systems an attempt is made to stir up and distribute these stratified layers of soil under the furrow. Difficulty arises in the fact that the bottom of the furrow is often quite wet when the first cultivation is made after the irrigation. The rest of the soil between the furrows may be in a shape to work, while that in the furrow is so wet as to puddle to an extent such as to make the condition much worse than it would have been without any disturbance at all. Again, many do not plow the soil, and constant cultivation at a relatively uniform depth will tend toward this condition even though the soil is not often too wet for cultivation. Considering the value of land in this part of the State, it is well to study the optimum conditions for cultivation after every irrigation. Temperature conditions will cause each cultivation to be somewhat different from the one preceding and no set rule can be given even for a single soil type regarding the time which should elapse between irrigation and cultivation.

It is becoming common knowledge that working the soil too wet is a bad practice, but few seem to recognise the fact that the same results can be obtained by over working dry soil. In stirring air dry soil, the individual soil particles tend to become separated and a fine dust is formed. This dust, upon being wet by irrigation, forms a puddle very similar to that resulting from stirring a soil saturated with water. For this reason cultivations after the soil mulch has become dry should be as few as are consistent with the maintenance of a proper moisture content in the soil.

Along the line of cultivation it may not be out of place to briefly discuss this subject from the broader standpoint of methods of soil handling. In brief, there are four common methods of handling soil in this part of the State. The most common method is that which calls for cultivation throughout the entire twelve months of the year. During the winter, cultivations are not as frequent as during the irrigation season, but the land is not permitted to really rest during any period of the year. In this way weeds are never permitted to seed and the land may be kept in a practically clean condition. Little work is required to keep the land in a tidy condition under the trees, and for a time very good results are often obtained.

That this method can not be expected to maintain the fertility of the soil indefinitely is becoming more and more evident. The soil, as well as everything else, requires a period of rest. The soil contains innumerable organisms essentially connected with the process of transforming the raw materials into available plant food.

The second most important method takes into consideration a period of summer cultivation and a period of soil rest during which time the growth of some crop to be used as green manure is permitted. This system is growing in favor each year. The organic content is better maintained by this method whereby yearly additions are made to the soil from the winter crop. The physical condition of the soil is also improved when this bulky material is turned under. Cultivation, high temperature and irrigation all tend to break up this material and supply it to the trees in soluble form. This system is giving very good results at Riverside where citrus trees under this treatment are showing excellent growth and yield. Under the clean cultivated conditions adjacent, the physical condition has become so bad that water penetrates the soil with difficulty and the beneficial effect of the fertilizers applied is becoming less marked.

The next most important system is that which does away with most of the cultivation and carries with it the growing of both a summer and winter cover crop. This system has been tried to quite an extent in this part of the State. Opinions as to its value vary, but in general this practice is extremely questionable with orchards where the trees are in full bearing. The main advantage of this system is its adaptation to young orchards where only a fraction of the land is actually occupied by the tree roots. As most of our virgin soils are very low in organic material, it is highly advisable to grow all the organic material possible during the early life of the tree. This is accomplished by not only growing a winter crop but by keeping the ground constantly occupied by a crop which may be used as green manure. With orchards of mature age there is frequently insufficient water and plant food in the soil during the summer to permit of the optimum conditions for the tree when in competition with a vigorously growing cover crop. Some of the advantages of this system, however, are that it tends to keep the soil cooler and cuts down the cost of cultivation. There is no question but that these advantages exist, but it remains to be determined whether they are sufficient to overbalance the losses resulting from the competition of the cover crop.

Another system is that in which a mulch of organic material is employed to prevent evaporation and keep the soil cool, furnish organic material and incidentally do away with cultivation. Theoretically, this system is the ideal one, and if all conditions are ideal, success is practically assured. We are, however, dealing with many conditions which are not ideal and which are practically impossible to change. For instance, the temperature and the low humidity during the summer months are factors which can not be controlled. It has not seemed practicable to apply water in the natural and ideal method, such as might be done by an overhead spray. Thus with certain uncontrollable factors, it is often necessary to do away with other ideal factors because of the changed conditions. In the first place the cost of the material necessary to properly mulch the surface is very high.

Again, irrigation is made more difficult by this bulky material on the surface. The fire risk from a mulch of dry material during the summer is an item not to be overlooked. With orchards which have been cultivated deeply and in which the roots of the trees have penetrated to considerable depth, the change from this deep cultivation to no cultivation will undoubtedly cause a temporary derangement in the feeding of the tree. This has been evidenced by certain work already done at Riverside.

Although there is much, in theory at least, which points to the value of this system, caution should be used in not putting in too large an area to this system of mulching until more information is available. It is as yet entirely in the experimental stage and should be considered as such until definite experiments of some duration have been completed. These are now under way at the station at Riverside and as soon as definite information is obtained published results of the same will be available.

To sum up these four systems, that system which employs a winter cover crop and cultivation during the summer is the most likely to suit all conditions of any of the systems discussed. The experiments now under way certainly point to this method as one which makes for the maintenance of the permanent fertility of our soil.

This subject leads directly to a discussion of cover crops, since the growth of such a crop during the winter is an important part of one of the most promising systems of cultivation. A cover crop may be used for several purposes. Winter cover crops were originally used to prevent the washing of the soil by the winter rains and in many cases these were made up of volunteer crops of bur clover, alfilaria and mustard. As these crops were plowed under earlier and earlier, the seed was not permitted to ripen and in a few years voluntary crops became sparse and of little value. Thus it was necessary to plant certain crops during the fall months which would be of rapid growth and protect the surface of the soil during the winter rains. The cereal crops were well adapted for this purpose and were the first cover crops planted in this State. They are, however, heavy consumers of water and in many cases it was impossible to get these crops turned under quick enough to prevent the land drying out to such an extent that plowing was practically impossible. Experience in the eastern states demonstrated that clovers always left the land richer for the crops which followed and many who had had experience along this line began experimenting with various leguminous crops to determine their adaptability to winter conditions.

Growers gradually came to use leguminous crops and of these, common spring vetch and Canada field peas were most popular. The seed of both these crops was relatively cheap and the supply large. In time, however, these crops began to fall off in yield and to become quite uncertain, due in part at least to the serious attacks of the green pea aphis, together with certain fungi which seemed to follow in the wake of this pest. This decline in the value of these two plants led many growers to go back to rye or barley as the winter cover crop. That this was a step backward seemed evident to many, and for the last six years the station at Riverside has been attempting to find a cover

crop of a leguminous nature which would be superior to the varieties in use.

A test of a number of possible legumes brought out the fact that the native yellow flowering sweet clover, *Melilotus indica,* was well adapted to our winter conditions. After seven years' experience with this clover there has been no crop which has been as uniformly satisfactory under our winter conditions. It is not adapted to all conditions, as no one plant ever is, but observations seem to show that this clover is doing better in most parts of the State than vetch or peas.

A new vetch which gives great promise, the purple vetch, is a recent introduction of the Department of Agriculture. It is very much more vigorous than the common vetch and for the lighter soils where a good stand of clover is difficult to obtain, this vetch will probably be superior to anything we have had in the past. At present the seed is not available, although the growing of this vetch for seed has recently been taken up by the Oregon growers. It is hoped that seed will be available to a limited extent this coming fall and that in a year or two a supply will be on hand sufficient to satisfy the demands.

These two crops, *Melilotus indica* and purple vetch, give more promise in the way of leguminous cover crops than any of the other varieties so far tested. In the absence of seed of the purple vetch, the use of Melilotus clover is recommended on all soils, provided there is sufficient water to germinate the seed in the fall. As the supply of purple vetch increases, it will probably prove superior to Melilotus clover on the sandier soils.

In regard to the adaptation of this work to apple growers, it may be said that any work which is taken up at an experiment station can only get at the principles involved and never be able to give prescriptions or formulas of practice, since it is impossible to duplicate soil and climatic conditions at one or a dozen places for every section and every ranch in the State. Certain experiments have been started in the apple growing sections in this vicinity and it is hoped that more definite information will be available regarding the varieties of legumes which will be most suited to these conditions. In the interim it is suggested that purple vetch be planted as soon as seed is available. If this vetch is planted early in September and given sufficient irrigation water to get it well started, it should have made considerable of a cover by Thanksgiving, when the weather becomes too cold for any rapid growth. The crop will, under ordinary conditions, winter without difficulty and make a very rapid development after the first of February. Melilotus clover is a crop which should be tried, although it will not make the early development which some other more rapidly growing plants evidence. If one is enabled to leave the land until April before plowing, Melilotus clover will make a satisfactory crop if planted not later than October.

A test of winter vetch, *Vicia villosa*, should be made also, since this crop has given such excellent results in the apple sections of Oregon. A mixture of this winter vetch with a thin seeding of oats seems to have given the best results under their conditions. Canada field peas gave good results in some sections when planted early, but did not seem to withstand the winter temperatures as satisfactorily as the vetches and clovers.

In conclusion, cultivation should never be attempted when the land is too wet, as more injury is apt to occur than can be overcome in a year's work. Cultivations should be made as frequently as is consistent with the maintenance of a proper moisture content in the soil. The soil type will of necessity determine the frequency and depth of cultivation. The system of cultivation which permits of a rest during the winter and the growth during this period of a winter cover crop, gives evidence of being the most satisfactory method in vogue at this time. The winter cover crop should be of a leguminous nature in order that nitrogen as well as organic material may be added through its incorporation in the soil. The practical adaptation of any principle will of necessity require individual study, since conditions of soil, climate and humidity vary within relatively short distances.

In short, the grower who will benefit by the work of the experiment station is the one who studies the principles evolved through the work of such a station, and uses judgment and common sense in the application of its principles to his own conditions.

CROP REPORT AND STATISTICS.

MONTHLY CROP REPORT.

(May 1, 1916.)

BY GEO. P. WELDON.

Compiled from the reports of the County Horticultural Commissioners.

Counties	Almonds (per cent)	Apples (per cent)	Apricots (per cent)	Berries (per cent)	Cherries (per cent)	Figs (per cent)	Grapefruit (per cent)	Lemons (per cent)	Olives (per cent)	Oranges (per cent)	Peaches (per cent)	Pears (per cent)	Plums (per cent)	Prunes (per cent)	Walnuts (per cent)
Alameda	65	#	50	90	10	#	#	#	#	#	#	80	—	30	—
Butte	20	—	#	#	50	100	#				30		35	30	#
Colusa														50	
Contra Costa	50	100	50	#	40	#	#	#	—	#	60	60	80	40	
El Dorado	#	80	#	#	60	#	#	#	#	#	85	60	60	60	#
Fresno	100	#	25	100	#	100	#	100	100	100	50	#	#	#	#
Glenn															
Humboldt	#	100	#	100	100	#	#	#	#	#	—	100	#	#	—
Imperial	#	#	80	#	#	100	#	#	70	#	#	100	#	#	#
Inyo															
Kern	#	—	75		#	100		#	—	100	85	—	90	100	#
Kings	#	#	50	#	#	#	#	#	#	#	90	#	#	100	#
Lake	50	100	50	100	50	75	#	#	—	#	75	75	#	75	—
Los Angeles	—	100	50	100	#	50	100	100	80	100	100	80	30	#	80
Madera	35	#	35	#	#	#	#	#		#	85	#	#	85	
Mendocino	100	100	50	—	100	#	#	#	#	#	80	85	#	100	100
Merced	100	#	50	100	#	100	#	#	—	#	55		#	#	#
Modoc	#	95	100	100	65	#		#	#	#	100	80	100	100	#
Monterey	—	75	35	90	25	#	#	#	#	#	90	50	50	50	#
Napa	#	90	15	100	30	#	#	#	#	#	60	80	100	40	#
Nevada	50	100	90	100	40	100	#	#	#	#	90	60	40	40	30
Orange	—	100	0	100	—	—	100	100	100	110	75	—	100	—	100
Placer	25	—	—	—	33	—	#	—	—	—	75	75	80	#	#
Riverside	100	75	30	#	50	#	100	100	100	100	80	50	#	75	50
Sacramento	65	90	85	100	85	#					75	70	75	60	
San Benito	100	100	40	—	50	#	#	#	#	#	85	100	#	50	
San Bernardino	#	50	30	#	75	#	100	100	80	100	60	50	80	80	100
San Diego	70	40	60	100	20	—	100	75	100	100	80	20	—	—	—
San Joaquin	40	80	25	#	25	#	#	#	#	#	75	80	60	75	#
San Luis Obispo	100	90	50	#	#	#	#	#	#	#	90	80	#	95	90
Santa Barbara	#	100	50	#	100	#	100	100	100	100	#	#	#	#	100
Santa Clara		70	50		15	#	#	#	#	#		60		50	#
Santa Cruz	#	80	40	75	25	#	#	#	#	#	75	30	#	25	#
Shasta	#	80	5	60	5	75	#	#	100	#	60	25	65		
Siskiyou	20	75	20	90	80	#	#	#	#	#	50	75	75	75	#
Solano*														50	
Sonoma	25	75		100	35	#		#		#	100	80	50	35	
Stanislaus	60	75	30	100	50	50	—	#	100	#	70	100	100	100	100
Sutter	75	80	#	#	#		#	#		#	65	50		75	#
Tehama	100	75	50	50	#	—	#	#	—	—	65	75	—	75	#
Tulare	#	—	30	#	#	—		—	—	—	90	#	90	100	#
Ventura	—	#	40	#	#	#	—	—	—	—	#	#	#	—	—
Yolo	65	#	40		#	—		#	—	#	75	80	90	50	#
Yuba	60	90	40	90	75	90	#	90	90	90	60	70	75	60	50

Figures in table indicate condition of crop in per cent, on the basis of 100 as normal.
—Horticultural commissioner has insufficient information for a report.
#Not grown commercially.
*No horticultural commissioner.
Report on apricots and prunes for San Benito and Santa Clara counties, and prunes for Colusa and Solano counties, copied from California Prune and Apricot Growers' Information Bureau Report of April 24, 1916.

STATISTICS.

Estimated per cent of the total crop of the principal California fruits grown in each of the main producing counties during a season of normal production. Compiled from the reports of the county horticultural commissioners.

Counties	Almonds (per cent)	Apples (per cent)	Apricots (per cent)	Cherries (per cent)	Figs (per cent)	Lemons (per cent)	Olives (per cent)	Oranges (per cent)	Peaches (per cent)	Pears (per cent)	Plums (per cent)	Prunes (per cent)	Walnuts (per cent)
Alameda	*		14	9						2	*	*	
Butte	12	*		*	3	*	14	*	3	2	*	2	
Colusa	4		*						*	*		*	
Contra Costa	11	*	*	*					*	6	*	*	
El Dorado		*		*					*	3	*		
Fresno			5		53	*	3	*	29			*	
Glenn	*		*								*		
Humboldt		2											
Imperial			*		*								
Inyo		*							*				
Kern		*	*					*	*	*	*	*	
Kings			5						6			*	
Lake	*	*	*						*	8		*	
Los Angeles	2	2	4		*	31	14	23	4	*	3	*	20
Madera	*	*	*		3		2		*			*	
Mendocino		*								*		*	
Merced	*		*		9		*		3				
Modoc													
Monterey	*	12	2	*						*			
Napa	*	*	*	*	*		*		*	4	*	4	
Nevada		3	*	*					*	*	*		
Orange			4			7		10					38
Placer	*	*		3	*		*		6	7	39		
Riverside	3	*	7	*		16	11	14	*	*		*	
Sacramento	6		*	5			5	*	*	18	8	*	
San Benito	*		6	*					*	*	*	3	
San Bernardino		4	4	*		13	7	31	5				2
San Diego	*	*	*			10	5	*	*				
San Joaquin	12		3	25	*		4		8	4	*	*	
San Luis Obispo	*	*	*										
Santa Barbara		*	*	2		*	2						10
Santa Clara	*	*	21	26	*				5	9	18	55	
Santa Cruz		51	2	2					*			*	
Shasta	*	*					*		*	*		*	
Siskiyou		*											
Solano	6		3	10					3	6	16	4	
Sonoma	*	16	*	9	*		5		*	6	*	12	
Stanislaus	6		*	*	5			*	3	*			
Sutter	9			*	[illegible]		*		2	*	*	*	
Tehama	*	*	*		*		11	*	*	2	*	*	
Tulare	*		*		6	5	6	13	9		2	4	
Ventura			6			15		2					20
Yolo	11		5		5		3		2	9	4	2	
Yuba	*				2		3	*	*	*	*		

*Less than 2 per cent of State's normal crop grown in county.

THE MONTHLY BULLETIN

CALIFORNIA STATE COMMISSION OF HORTICULTURE.

DEVOTED TO HORTICULTURE IN ITS BROADEST SENSE, WITH SPECIAL REFERENCE TO PLANT DISEASES, INSECT PESTS, AND THEIR CONTROL.

Sent free to all citizens of the State of California. Offered in exchange for bulletins of the Federal Government and experiment stations, entomological and mycological journals, agricultural and horticultural papers, botanical and other publications of a similar nature.

A. J. Cook, State Commissioner of Horticulture----------Censor
E. J. Vosler, Secretary State Commission of Horticulture----------Editor

ASSOCIATE EDITORS.

Geo. P. Weldon----------Chief Deputy Commissioner
Harry S. Smith----------Superintendent State Insectary
Frederick Maskew----------Chief Deputy Quarantine Officer

Entered as second class matter December 29, 1911, at the post office at Sacramento, California, under the act of July 16, 1894.

Alfalfa Weevil Quarantine Conference.—An important conference of quarantine representatives of seven western states was held in Salt Lake City, Utah, April 20th and 21st.

This conference was called by Governor William Spry of Utah who, through the governors of other states, invited quarantine officials to attend. The purpose of the meeting was to discuss the alfalfa weevil and, if possible, agree on uniform quarantine regulations governing the entrance of products or commodities liable to carry the weevil from the infested to the noninfested states.

The conference brought out the fact that there is grave danger of the weevil gaining entrance in sacks of potatoes, because of the fact that green alfalfa is often used to cover the potatoes, as tules are used in California. In Montana, a number of weevils have been taken in potato cars. It was the opinion of those present that some restrictions should, therefore, be placed on the shipping of potatoes from Utah into other states, and that such restrictions should compel the screening of all potatoes before shipment, and transference to clean sacks, the State Inspector of Utah to certify under oath to this work being done.

Emigrants moving from an alfalfa weevil state are apt to use hay, or other material containing alfalfa weevils, in packing goods or cars, hence the seeming necessity for restrictive quarantine measures in this

case. It was the opinion of those present that the State Horticultural Inspector of Utah should certify, under oath, that every carload of emigrant movables was free from material liable to carry alfalfa weevil, before it could leave the state.

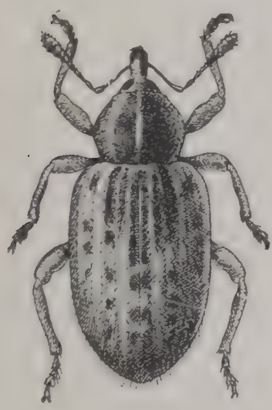


FIG. 61.—Adult alfalfa weevil Greatly enlarged. (After Webster, U. S. Dept. of Agric.)

No good reason could be given by anyone present for a quarantine on alfalfa seed, or bees.

Every state except Utah favored an absolute quarantine on hay and cereal straw.

The conference was characterized by a spirit of fairness throughout, and the practically unanimous action of those present indicates the possibility of more uniform regulations in the western states.

Following is a copy of a ballot giving the result of a vote taken by states, during the conference. This vote shows the unanimity of sentiment among the representatives of the states in attendance.

	Ariz.	Cal.	Colo.	Idaho	Mont.	Utah	Wyo.
Fruits	yes	none	none	none	rest.	none	none
Alfalfa seed	none	none	none	none	none	none	none
Hay	yes	yes	yes	yes	yes	--------	yes
Straw, cereal	yes	yes	yes	yes	yes	none	yes
Bees in hives	none	none	none	none	none	none	none
Agricultural emigrant movables	rest.	rest.	rest.	rest.	rest.	rest.	rest.
Live stock	rest.	rest.	rest.	rest.	rest.	rest.	rest.
Grain	none	none	none	none	none	none	none
Vegetables	none	none	none	none	rest.	none	none
Potatoes	rest.	rest.	rest.	rest.	rest.	rest.	rest.
Nursery stock	rest.	rest.	rest.	rest.	rest.	rest.	rest.

Yes—Absolute quarantine.
None—No quarantine.
Rest.—Restrictive quarantine.

G. P. W.

Thistles.—A great deal has been said lately about the eradication of noxious weeds, but apparently it is necessary to keep the warning in constant motion that the sins of the careless may not live to do damage to those who try to keep their lands clean.

Last year Butte County had a serious fight with yellow star thistle, and there was some talk of obtaining State action to enforce eradication. The rice growers of the State are facing an ever increasing menace in the shape of weeds such as water grass, red rice and sedge. Thoughtlessness in regard to these weeds has already forced many enthusiastic rice growers to the wall.

At the present writing all the grain has been sown. It is now up to the farmer to get the maximum crop. Due to the lack of rain some are not going to get a crop this year. Exceptional care, therefore, should be taken to keep down the weeds. In the absence of the cultivated crop the thistles will grow abundantly. Keep them down—clean them out—so that next season when crop conditions are better they will not be there to reduce the value of the land and the crop.

The time to cut bull thistles, yellow star, sow thistle, milk thistle and others is NOW. Don't let it go until the heads are ripe and the wind has scattered the seeds over the whole country.

It might be well to say that the country is not the only region infested with thistles or the only source of infestation. Many city lots provide as excellent a source of infestation for the surrounding country as can be imagined. There is a law providing for the eradication of weeds in the cities, and the owners of clean or cleared land should make it their duty to see that this law is enforced.

Every man should be his brother's keeper where thistles are concerned, for he can not keep his harvest at home. The wind will transport the seeds for miles and untold damage may be done to some other farmer as the result of the failure of each property owner doing his part this year. It is only through co-operation that we can expect to eradicate our serious weed pests. A State law will help, but unless the farmers wake up to the importance of pure seed and clean land, and realize that it will make a big difference in their annual income, such a law will only amount to series of words and phrases. If we did not believe what we are saying we would not waste our time writing and studying these same pests. Experience in other states has taught us that what we say is absolutely true and the sooner the farmers of the State of California realize it the better will be their chances for success.—O. W. NEWMAN.

Protecting Tree Trunks from the Sun.—Whitewashing the trunks of fruit trees, young or old, to prevent sunburn, is commonly practiced in California. A good formula for whitewash is the following:

Quicklime	30 pounds
Tallow	4 pounds
Salt	5 pounds
Water	enough to make the mixture flow well

—E. J. V.

Alfalfa Weevil Inspection.—The annual inspection of the alfalfa fields along the Salt Lake Route in San Bernardino County was made in April. The territory from Kouns to Victorville was carefully examined, and fortunately for California alfalfa growers, no weevils were found. As has been previously written, the Salt Lake route traversing the alfalfa districts of Utah where the alfalfa weevil is most destructive, may become a factor in the distribution of this insect. About the same number of acres—740—is reported this year as last. While some plantings were made since the last inspection, the floods of last winter were responsible for the washing away of parts of fields adjacent to the Mojave River.—E. J. V.

NOTES ON THE TOMATO PSYLLA.

By Harold Compere.

Specimens of *Paratrioza cockerelli* Sulc., a small Hemipterous insect belonging to the family Psyllidæ, were confined in the Insectary for the purpose of rearing their parasites. Incidentally, a few observations on their habits were made which are noteworthy.

Psyllids are intermediate in form, between the scales and plant lice on the one hand and cicadas and larger plant bugs on the other. The adults have gained the name of jumping plant lice because of their habit of springing quickly into the air by means of their powerful hind legs. When once in the air flight is maintained by the wings, although they seldom fly more than a few feet.

The specimens were determined by D. L. Crawford, who, in his monograph of the Psyllidæ of the world, gives the distribution of this species as covering the entire southwestern part of the United States, and lists the following eight hosts, although all of these may not be true food plants: pepper (*Capsicum annum*), tomato (*Solanum nigrum*), potato (*Solanum tuberosum*), *Purshia* sp., arbor vitæ (*Thuja occidentalis*), spruce (*Picea* sp.), pine (*Pinus monophylla*), alfalfa (*Medicago sativa*). Crawford says that this insect is often found in great numbers, sometimes becoming a pest to cultivated plants. Our specimens were found in the Capitol Park infesting the Jerusalem cherry (*Solanum capsicastrum*). In Golden Gate Park, San Francisco, the solanums that were infested with this Psylla were rendered worthless.

THE ADULT.

The adult is a small, active, clear-winged insect greatly resembling a miniature cicada or harvest fly. Like the latter, the wings are held roof-like over the back. The color is variable, but this species can easily be distinguished by the striking coloration of the body. The ground color is usually dark, the markings varying from white to gray in color.

Feeding Habits.—The feeding habits of the adult are about the same as those of the nymph, except that the adult shows more activity. The

Fig. 62.—Adult of *Paratrioza cockerelli* Sulc. Enlarged about 12 times. (Original.)

Fig. 63.—Egg of *Paratrioza cockerelli* Sulc. Greatly enlarged. (Original.)

adults are present at all seasons and easily located. When approached they try to conceal themselves among the stems and leaves before taking flight. In captivity they lived more than one month.

Copulation and Oviposition.—Three days after the adults were seen mating, egg laying began and continued three days. When about to deposit an egg the female lowers the abdomen and extrudes the ovipositor which comes in contact with the plant. She remains in this position for several minutes, during which the egg stalk passes into position and is firmly cemented to the plant. When the cement has set the female quickly withdraws her ovipositor, leaving the egg and stalk in an upright position. After the egg is placed the Psylla walks away and usually begins feeding.

THE EGG.

The egg is minute, smooth and shiny, about 1/80-inch in length and 1/200-inch in width, obtusely rounded at one end, somewhat tapering at the other. The dorsal surface is slightly concave. The egg is supported in an upright position by a short pedicle. When first laid it is of a light yellow color, but darkens posteriorly as the embryo develops. In advanced stages the two red eyes of the immature insect are visible through the transparent eggshell. Eggs are deposited singly on all surfaces of the leaves and young growth. The number deposited by three females under observation averaged thirty-six. Egg laying began three days after mating and continued three days. The incubation period in a hothouse was fifteen days.

The Hatching Process—After the shell is split the nymph propels itself forward by body movements until the legs are free, after which it rests for several minutes. When work is resumed the nymph frees itself from the shell, but remains head downward clasping the empty shell and stalk for about fifteen minutes, after which it descends to the plant, clasping the pedicle for support. Usually the newly hatched nymph immediately crawls to the under side of a leaf, inserts its beak into the tissues and begins feeding.

THE NYMPHS.

When first hatched a nymph is minute, only slightly larger than the egg. The body is flattened and oval in shape, semi-transparent, the abdomen being partly yellowish. The eyes are red and conspicuous. The margin of the body is fringed with numerous wax glands which give rise to glandular hairs. These hairs are cast with each moult. The glands about the anus cover the liquid excrement with a layer of wax as it passes out, so that it is slowly and gradually discharged in tiny white pellets which, if undisturbed, gather in large quantities, giving the plant the appearance of having been sprinkled with sugar. The nymphs are usually content to remain quietly feeding, only occasionally moving to more favorable locations.

Later the color markings are variable. Usually brownish, orange or greenish markings appear on the body and head a short time after the first moult, and wing pads appear as lateral buds. In the advanced nymph the hinder segments of the abdomen appear to be fused together, the traces of segmentation being obliterated. The great wing pads are the most conspicuous feature. The nymph passes through five instars,

the duration of these varying from three to ten days. The time occupied from the first hatched nymph to the adult averages about thirty days.

In Sacramento the broods are continuous throughout the year, all stages of the insect being present. During January the death rate of the newly hatched young was high, about one-half dying, this probably being caused by the unusually cold weather.

CONTROL.

A strong stream of water played on the infested plants that were under observation sufficed to destroy the insects. If this can not readily be done, spraying must be resorted to. On tender ornamentals,

Fig. 64.—Nymphs showing the comparative size of the different instars. Greatly enlarged. (Original.)

Black Leaf 40, at a strength of 1 to 1,500, is recommended. On hardy, resistant plants kerosene emulsion can safely be used. For this purpose a stock solution of one part of kerosene to two parts of water should be used at the rate of one gallon of the emulsion to twenty gallons of water.

TWO NEWLY-ESTABLISHED SCALE INSECTS.

Order—Hemiptera. Family—Coccidæ.

By E. O. Essig, Department of Entomology, University of California, Berkeley, California.

Among the insects which have been imported into this State from other countries are a number of scale insects (Coccidæ), and several of these are now the most serious pests to be found in the orchards. Recently two more of these insects have been found within the State and are established in small colonies in limited districts. These are the camellia scale, *Pulvinaria floccifera* (Westwood) and the dictyospermum scale, *Chrysomphalus dictyospermi* (Morgan).

THE CAMELLIA SCALE.

Pulvinaria floccifera (Westwood).

Coccus floccifera Westwood, Garden Chronicles, p. 308, 1870.

(Figs. 65, 66, 67.)

This scale has been taken in quarantine at the ports of entry for many years and is at the present time established only in one locality, San Jose, California, where it was taken last year by Horticultural Commissioner Earl Morris and Horticultural Inspector R. L. Cody, of Santa Clara County. The specimens received by the writer from these collectors were forwarded to Mr. Geo. B. King, Lawrence, Massachusetts, who gave the above determination and who further stated that the insect had previously been listed from this State by officials as *Pulvinaria camelicola* Sign., which name is synonymous with and replaced by the older *Pulvinaria floccifera* (Westw.). A published description of the insect appears first in California literature in the "Annual Report of the State Board of Horticulture," pp. 191–192, 1890, but no mention of its occurrence in the State is made. Among the insects taken in quarantine at San Francisco, Mr. Alexander Craw, on December 30, 1892, lists *Pulvinaria camelicola* Sign. from Japan.[1] In 1909, Mr. R. S. Woglum lists this as a California insect, but no further data were given at the time.[2] Again, in 1912, Mr. B. B. Whitney published another record of its being taken in quarantine at San Francisco from Japan.[3]

The mature females (Figs. 65 and 66) are very conspicuous because of the long, narrow pure white egg-sacs at the posterior ends which are three or four times as long as the bodies and which are very noticeable on the dark green leaves of the camellia plants. The bodies are yellow or pale amber-brown and soon after egg-laying dry up, become detached and drop from the plants so that it is a common thing to find only the old egg-sacs on the leaves and stems. The antennæ (Fig. 67A) are 8-jointed and sparsely covered with long spine-like hairs. The breathing spines (Fig. 67C) are in groups of three, one long and two less than half as long. The bodies are covered with rather long, simple and

[1]Insect Life, Vol. V, pp. 281-282, 1893.
[2]Baker and Essig, P. Jr. Ent., Vol. I, No. 2, p. 56, June, 1909; Monthly Bul. Cal. Hort. Com., Vol. I, No. 10, p. 745, Sept., 1912.
[3]Monthly Bul. Cal. Hort. Com., Vol. I, p. 739, 1912.

branched spine-like hairs (Fig. 67E). The leg, tarsus and anal valves, are shown in the drawing (Fig. 67B, D, F).

The young are pale, yellowish-green, or amber and resemble in shape and color the soft, brown scale, *Coccus hesperidum* Linn.

FIG. 65.—Branch of camellia showing females of the camellia scale, *Pulvinaria floccifera* (Westw.). In most cases the bodies have dropped off leaving only the white egg-sacs. Natural size. Original. (Photo by Dept. of Sci. Illust., Univ. of Cal.)

In California this species is known to be established only at San Jose, as previously stated. It is a cosmopolitan insect, occurring in most temperate regions and has been taken in the southern and eastern parts of the United States and in Canada.

As the common name implies, the preferred host plant is the camellia and especially the Japanese species, *Camellia japonica*. Other food plants listed are: *Euonymus* sp., *Oncidium papilio*, *Calanthe natalensis*, *Anguloa clowesii*, *Lycaste skinneri*, *Acalypha* sp., *Brassia verrucosa*, *Phaius maculatus*,[4] coffee,[5] and *Euonymus alata*.[6]

[4]Catalogue Coccidæ, pp. 130, 132, 1903.
[5]Insect Life, Vol. VI, p. 334, 1894.
[6]Jr. Ec. Ent., Vol. III, p. 275, 1910.

FIG. 66.—The camellia scale, *Pulvinaria floccifera* (Westw.). The three specimens together are intact, while in the other two the bodies have dropped from the leaf leaving only the egg-sacs. Enlarged. (Original. Photo by Dept. of Sci. Illust., Univ. of Cal.)

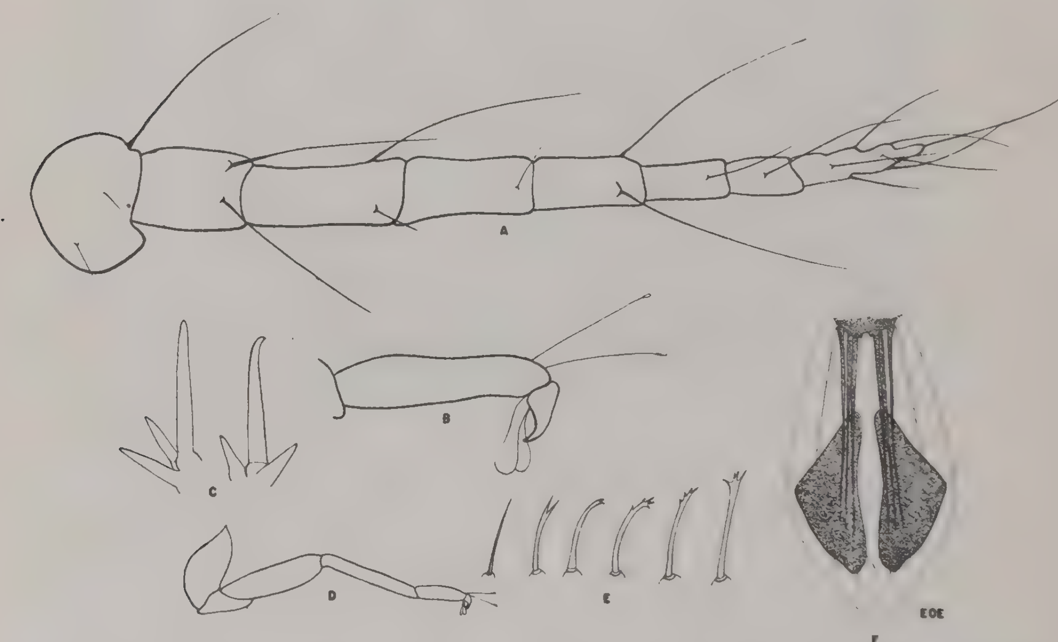


FIG. 67.—Anatomical details of the camellia scale, *Pulvinaria floccifera* (Westw.). *a*, antenna; *b*, tarsus; *c*, breathing spines along the margin of the body; *d*, leg; *e*, simple and branched spine-like hairs on the body; *f*, anal-valves and spines. Enlarged. (Original.)

So far control measures have never been found necessary. Oil emulsions and miscible oils will readily kill the immature forms during the winter months, and in cases of severe infestations should be used at that time.

THE DICTYOSPERMUM SCALE.

Chrysomphalus dictyospermi (Morgan).

Aspidiotus dictyospermi Morgan, Ent. Mon. Mag., Vol. XXV, p. 352, 1889.

(Figs. 68, 69, 70.)

This scale has a very wide distribution throughout the tropical and subtropical world and occurs in greenhouses in many parts of the temperate regions. It has been found in many places in the United States and has a limited distribution in California, but only in greenhouses or very mild and protected places. It was first reported by the United States Department of Agriculture (Bureau of Entomology) in this State in 1909.[7] A variety, *Chrysomphalus dictyospermi arecæ* (Newstead) was taken by Mr. B. B. Whitney on orchids in Golden Gate Park, San Francisco, in 1913.[8] In 1915, County Horticultural Commissioner A. A. Brock took the species on a few kentia palms in Ventura,[9] and the plants were destroyed at the time. The writer finds it abundant now on kentia palms in the greenhouse on the campus of the University of California at Berkeley.

The writer has also received specimens taken on kentia palms taken at Marysville by G. W. Harney (November 1, 1915), and at San Diego (November 19, 1915). There are specimens in the collection of the University on avocado taken at the University greenhouse.

The scales of the females (Fig. 68) vary from light grayish-white to reddish or amber-brown, and are circular or slightly elongated, with the exuviæ central or subcentral, depressed or nipple-like and from light-yellow to reddish-brown in color. The exuviæ may or may not be surrounded by a depression or ring-like ridge.

The bodies of the females (Fig. 69) are oval, or somewhat tapering towards the posterior end, especially in the immature forms. There are three pairs of distinct lobes on the pygidium (Fig. 70), as follows: the median pair large with a notch on the outside margin near the middle; second pair nearly as large, with notch on the outer margin near the middle; third pair much smaller, with one or two notches on the outer margin. There are two divided plates, or pectinæ, between the median lobes, two between the median and second pairs, three between the second and third pairs, and following the third pair there are three very large conspicuous ones with enlarged bases, which greatly aid in distinguishing the species. There are four prominent dark linear areas, or paraphyses, at the bases of the lobes as shown in illustration (Fig. 70). The posterior circumgenital pores consist of from two to three in each group and the anterior from three to four.

The recorded food plants in this State are kentia palms,[10] orchids[11] and *Cœlogyne cristate*.[12] It has also been taken on avocado in the University greenhouse, as already stated. In other regions it has been found to attack the following plants as well as those already listed:

[7]Baker and Essig, P. Jr. Ent., Vol. I, pp. 58, 61, 1909; also Monthly Bul. Cal. Hort. Com., Vol. I, No. 10, pp. 747, 751, 1912.

[8]Monthly Bul. Cal. Hort. Com., Vol. II, p. 583, 1913.

[9]Monthly Bul. Cal. Hort. Com., Vol. IV, p. 116, 1915.

[10]Baker and Essig, P. Jr. Ent., Vol. I, p. 61, 1909.

[11]Whitney, B. B., Monthly Bul. Cal. Hort. Com., Vol. II, p. 583, 1913.

[12]Baker and Essig, P. Jr. Ent., Vol. I, p. 58, 1909.

Dictyospermum album, *Erythrina indica*, sago palm (*Cycas* sp.), *Latania* sp., palms, mango, croton rose, *Pandanus graminifolius*, *Areca triandra*, *Cypripendium* sp., *Dendrobium* sp., *Anthurium* sp., *Aloe zeyheri*, tea,[13] india rubber (*Ficus* sp.).[14] Both Woglum[15] and Quayle[16] report this insect as a serious enemy of citrus trees in Spain, Italy and Sicily. It attacks mainly the leaves and fruit, but is also found on the twigs. This aspect of the insect is a serious one for California and one that should increase our vigilance in keeping it from gaining a foothold.

FIG. 68.—The dictyospermum scale, *Chrysomphalus dictyospermi* (Morgan) on kentia palm leaf received from A. A. Brock, Ventura, California. Enlarged slightly. (Original. Photo by Dept. of Sci. Illust., Univ. of Cal.)

Control measures have never been resorted to in this State, except to completely destroy infested plants, and this is the sure means of preventing it from becoming established. If the insect does become an orchard pest, it will probably be necessary to resort to the same methods as used for the red scale, *Chrysomphalus aurantii* (Mask.), which is a very close relative.

[13]Fernald, Mrs. M. E., Cat. Coccidæ, p. 290, 1903.
[14]Herrick, Prof. G. W., Tech. Bul. No. 2, Miss. Agrcl. Exp. Sta., p. 11, Feb., 1911.
[15]Woglum, R. S., Bul. No. 120, Bur. Ent., U. S. Dept. Agric., pp. 49, 50, Feb. 28, 1913.
[16]Quayle, Prof. H. J., Bul. No. 134 (Prof. Paper), U. S. Dept. Agric., pp. 15-17, Oct. 7, 1914.

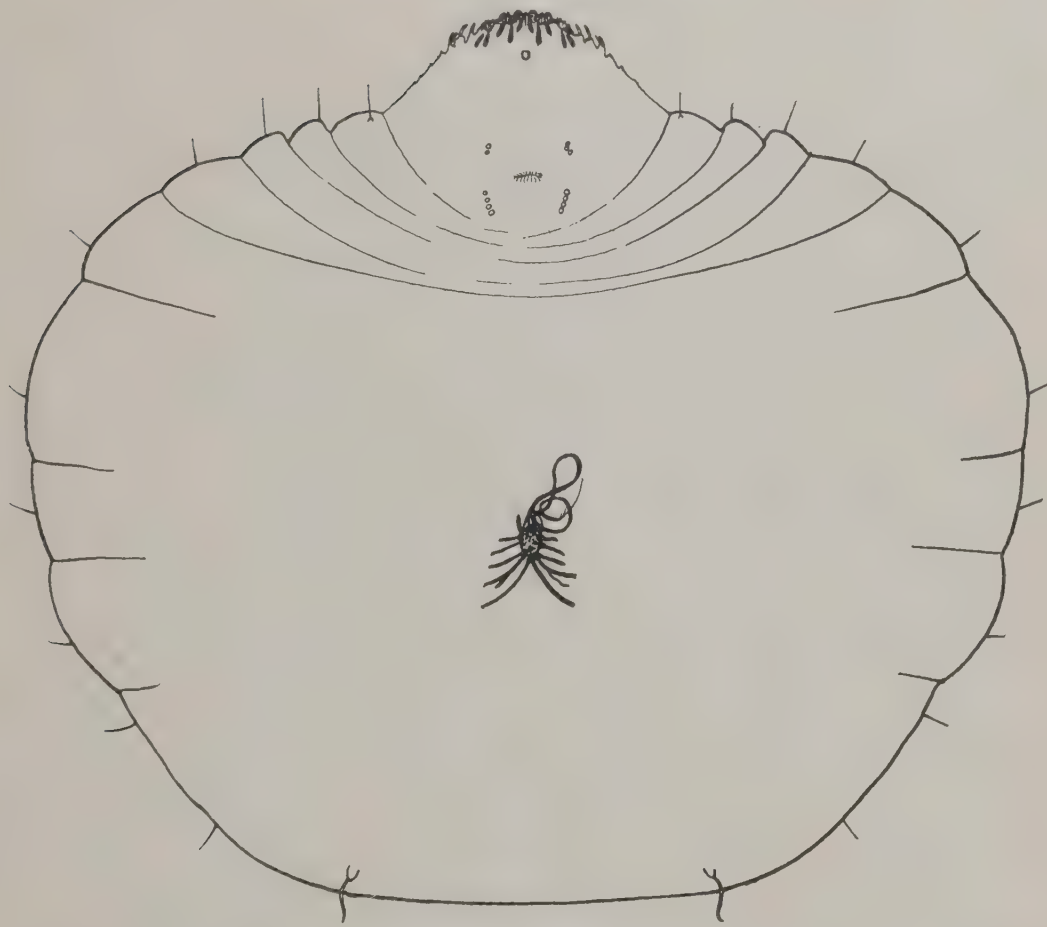


FIG. 69.—The dictyospermum scale, *Chrysomphalus dictyospermi* (Morgan). Body of mature female showing general anatomical characters. Greatly enlarged. (Original.)

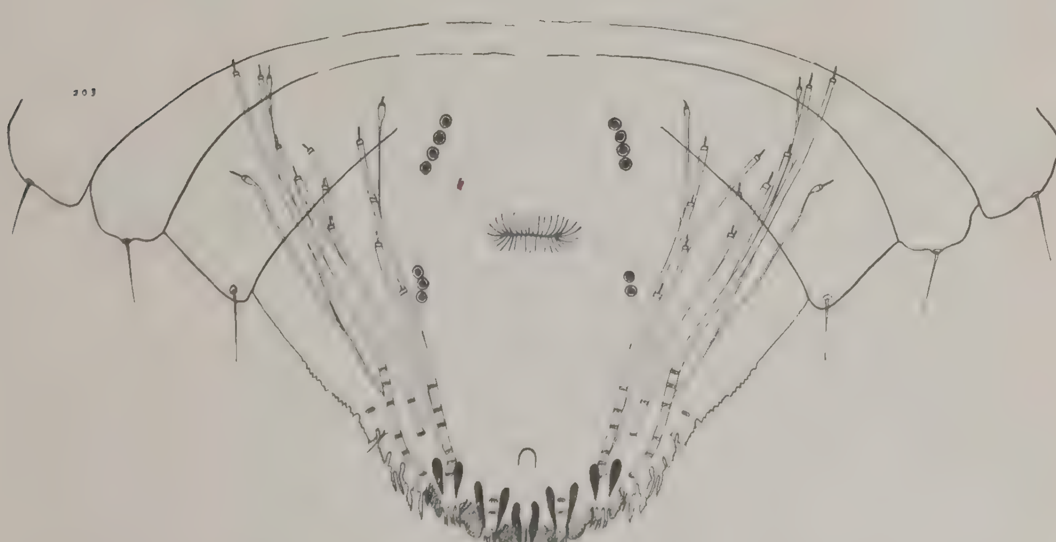


FIG. 70.—The dictyospermum scale, *Chrysomphalus dictyospermi* (Morgan). Pygidium of mature female. Greatly enlarged. (Original.)

QUARANTINE DIVISION.

REPORT FOR THE MONTH OF MARCH, 1916.

By FREDERICK MASKEW.

In the proper place in this itemized record of the work of the month appear a few figures in the following sequence: 4,167. This represents the number of passengers arriving at the port of San Francisco during the month of March from points outside Continental United States. The personal belongings of all these passengers were opened and the contents examined, by and with the authority of certain federal regulations, for the presence of dutiable or contraband articles. Out of the 4,167 passengers, 1,562 came direct from the Territory of Hawaii, and under United States Customs regulations their belongings were exempt from inspection. Under Plant Quarantine regulations the examination of the baggage of these one thousand five hundred and sixty-two, which amounted to 3,353 separate pieces, devolved entirely upon the six horticultural quarantine officers stationed at this port. It is difficult to grasp the volume of work represented by these four simple numerals, or to appreciate the amount of tact required to accomplish the same without friction, yet such work is done regularly and systematically each week in the year. The searching for contraband fruit and plant products in the personal belongings of all passengers on the domestic ships arriving from Hawaiian ports is the most delicate task assigned to the Quarantine Division. It is also considered by far the most important of its multifarious duties, and no efforts have been spared in developing and perfecting the details of this work. The thoroughness and celerity with which the same is carried out on each occasion vouch for the value and success of the educational features of a system which advises and prepares the passengers in advance for this ordeal, as also for the courtesy and dexterity of the inspectors in the actual performance of this unpleasant duty.

SAN FRANCISCO STATION.

Steamship and baggage inspection:

Ships inspected	71
Passengers arriving from fruit fly ports	4,167

Horticultural imports:

	Parcels
Passed as free from pests	162,033
Fumigated	2,074
Refused admittance	165
Contraband destroyed	50
Total parcels horticultural imports for the month	164,322

Pests Intercepted.

From China:

Chionaspis sp. on unknown plant.

From Hawaii:

Pseudococcus bromeliæ and *Diaspis bromeliæ* on pineapples.
Coccus longulus on betel leaves.
Lepidosaphes beckii, *Lecanium* sp. *Ischnaspis longirostris*, *Morganella maskelli*, *Howardia biclavis*, *Parlatoria pergandii* and *Chionaspis* sp. on plants and cuttings.
Coleopterous larvæ in melon seeds.
Hemichionaspis minor on green cocoanuts.
Chionaspis sp. on air plant.

From Japan:

Pseudaonidia duplex and *Pseudococcus* sp. on azaleas.
Larvæ of leaf roller on pines.
Weevil in chestnuts.
Antonina crawi on bamboos.

From Massachusetts:

Heliothrips hæmorrhoidalis on citri trees.

From Mexico:

Lepidosaphes gloverii on limes.
Weevil in beans.

From Oregon:

Lepidosaphes ulmi on unknown species of deciduous tree.

From Papeete:

Carpophilus hemipterus and Lepidopterous larvæ in avocado seed.
Coleopterous borer in palm seed.

From Samoa:

Fungus on oranges.

From Valparaiso:

Lepidopterous larvæ in potatoes.

LOS ANGELES STATION.

Ships inspected	34

Horticultural imports:

	Parcels
Passed as free from pests	104,980½
Fumigated	218
Refused admittance	25½
Contraband destroyed	18
Total parcels horticultural imports for the month	105,242

Pests Intercepted.

From Central America:

Aspidiotus cyanophylli, *Icerya* sp., and *Aspidiotus cydoniæ* on bananas.

From Hawaii:

Howardia biclavis on Hibiscus cuttings.
Diaspis bromeliæ and *Pseudococcus bromeliæ* on pineapples.
Pseudococcus sp. and *Howardia biclavis* on guava roots.

From Idaho:

Rhizoctonia on potatoes.

From Iowa:

Eriosoma lanigera on *Malus scheideckeri*.

From Japan:

Ceroplastes ceriferus, *Pseudaonidia pæoniæ* and *Lepidosaphes lasianthi* on camellias.
Hemichionaspis aspidistræ and *Chrysomphalus ficus* on *Aspidistra lurida*.
Lepidosaphes newsteadi on umbrella pines.

From Louisiana:

Aleyrodes sp. on cape jessamine.
Lepidosaphes lasianthi on camellia.

From Mexico:

Acanthoscelides obtectus in beans.
Chrysomphalus aonidum and *Aspidiotus* sp. on cocoanuts.

From Ohio:

Aleyrodes sp. on lemon plant.

From Oregon:

Rhizoctonia on potatoes.

From Utah:

Lepidosaphes beckii and *Phomopsis citri* on grapefruit.

SAN DIEGO STATION.

Steamship and baggage inspection:

Ships inspected	29
Fish boats inspected	33
Passengers arriving from fruit fly ports	200

Horticultural imports:

	Parcels
Passed as free from pests	9,275½
Fumigated	1
Refused admittance	3
Contraband destroyed	8½
Total parcels horticultural imports for the month	9,288

Pests Intercepted.

From Florida (via Chicago, Illinois):

Lepidosaphes sp. on oranges and grapefruit.
Melanose fungus on grapefruit.

From Illinois:

Crown gall on deciduous stock.

From Iowa:

Crown gall on deciduous stock.

From Nebraska:

Woolly aphis, root knot and crown gall on deciduous stock.

From Texas:

Crown gall on deciduous stock.

EUREKA STATION.

Steamship and baggage inspection:

Ships inspected	7

Horticultural imports:

	Parcels
Passed as free from pests	171
Fumigated	------
Contraband	------
Total parcels horticultural imports for the month	171

SANTA BARBARA STATION.

(No report.)

THE MONTHLY BULLETIN.

CALIFORNIA STATE COMMISSION OF HORTICULTURE

Vol. V. June, 1916. No. 6

CROWN GALL OR PLANT CANCER.

By CLAYTON O. SMITH, Instructor in Plant Pathology, Citrus Experiment Station, University of California.

The disease called crown gall, black knot, plant tumor, or plant cancer, has for many years been well known to the horticulturist and the plant pathologist. It is only within a few years that the cause of the trouble has been thoroughly investigated by Dr. Erwin F. Smith and his associates of the United States Department of Agriculture, and their bulletins are available to any who may be especially interested in this trouble.

Crown gall is nearly world-wide in its distribution, being found in all parts of the United States, in Canada, South Africa, Asia, the countries of Europe, New Zealand, Australia, Mexico and probably also in South America.

The malady is a serious one on many of our orchard trees, as it not only decreases their vigor and productiveness, but also at length is a frequent cause of their death. A large number of different species of trees are susceptible. In fact, the organism causing the disease is almost omnivorous as to its choice of a host, but it is especially severe on the more important economic trees, such as the apple, almond, apricot, cherry, grape, peach, plum, prune and walnut.

GALLS OR KNOTS.

The disease, when once seen, is easy to identify, as it is characterized by an enlargement or growth of soft, spongy tissue of a more or less spherical shape. These growths are usually situated just below the surface of the ground on the trunk or body of the tree, often extending downward some distance on the larger roots, and may be found on them at some distance from the trunk. The galls continue to increase in size from year to year until a large excrescence may be formed. The tissue produced is abnormal and easily decays, making an especially favorable place for wood-destroying fungi to gain an entrance to the tree. While the galls are usually below the ground, occasionally aerial ones are formed on the trunk and large branches. These are hard and cause little or no serious effects on the tree, except when they may be numerous as on grapes of the Vinifera varieties.

Trees affected with the disease may not die for some years, indeed will not until the trunk is entirely surrounded with diseased gall tissue. The affected trees usually do not make as rapid growth as healthy ones, but for a time produce a large amount of fruit. The cause of the abnormal amount of fruit is the same as in twigs that have been ringed to make them productive. The root of the tree suffers most and soon ceases to

make further growth because of the lack of elaborated food supplied it from the leaves. Severely diseased trees may show improper developed trunks, in that they are flattened or have deep grooves directly above the galls. In our study of crown gall, we have found these two characteristics an indication of its presence.

FIG. 71.—Crown gall, natural infection in a root of Royal Hybrid walnut two years after planting from seed in a nursery where the soil was artificially inoculated with minced galls. (Original.)

GROWTHS RESEMBLING CROWN GALL.

All abnormal growths of trees are not caused by crown gall.

(1) Some of these other sorts of enlargements are caused by insect stings or by their placing their eggs in the plant tissue. (2) Some of the galls in the roots are caused by small worms called nematode worms. These closely resemble small crown galls and are found on the roots of trees and vegetables. (3) Certain species of fungi are capable of causing galls, one fine example of this is the galls produced on citrus twigs in Cuba and Porto Rico by a fungus called *Sphaeropsis tumefaciens.* (4)Tubercles are found on many leguminous plants. (5) A gall caused by a different species of bacteria from that of crown gall is

found on sugar beets. (6) The knot or gall of the olive is caused by a distinct species of bacteria. In addition to these there are other aerial galls on the twigs of several different kinds of trees, the cause of which is not yet fully understood. Citrus trees occasionally have these aerial galls, also eucalyptus seedlings have small knots that never cause any serious injury. The galls of quince are not very well understood and do not seriously harm the affected trees. There are also natural galls on certain varieties of olives that should not be confused with that of crown gall. Locust trees sometimes have large galls on the trunk which probably are not the same as crown gall.

BACTERIAL NATURE OF DISEASE.

The cause of crown gall has been fully demonstrated to be a species of bacteria by the name of *Bacterium tumefaciens*, a tumor-forming organism. The germs are extremely small and may live in the soil or organic matter as saprophytes, and from there enter into the tissue of living plants through some injury in the bark. Artificial galls have been repeatedly made to develop by simply pricking the healthy bark with a steel needle previously touched to a pure culture of the causal organism. In the gall or tumor tissue comparatively few viable bacteria are present, and the microscope does not conclusively demonstrate the cause of the trouble under ordinary histological methods. The germs live inside the cells of the host, and, by the products produced during their development, cause new cells to be formed with unusual rapidity and in increased numbers. The abnormal tissue thus formed shows cells with very thin walls and it is at first soft and often with no well defined bark or epidermis. The germs can often spread through the plant by the developing of a narrow portion of tissue into a tumor strand. This strand is invisible externally, but from it secondary tumors often develop.

Strong evidence has been presented by Dr. Erwin F. Smith showing many similar characteristics to exist between human tumors and those of plants, but to present these would be outside the scope of this paper. All attempts, however, to produce tumors on the lower animals, fishes, frogs, by inoculating them with crown gall organism have been failures, or at least uncertain in their results. It is, therefore, safe to conclude that the organism causing plant gall tumors can not produce tumors in animals.

VIRULENCE OF THE ORGANISM.

The crown gall organism, however, is a virulent plant parasite, and is capable of producing galls in a large number of plants when placed in their tissue by artificial inoculations. Galls have thus been produced artificially on several kinds of trees upon which they have never been found to occur naturally. The most interesting of these are the different species of citrus, as the orange, lemon and lime. Negative results have always been secured from inoculating the avocado and the olive. The fig and loquat are infected only with difficulty. Often the inoculations when made do not at once show positive gall formation, but may, as in the quince, remain in a dormant condition. In our quince inoculations the injury made by the puncture inoculations healed, and it was nearly a year before the small gall-like formations appeared. These eventually, however, grew into large galls. The condition of the tree

growth affects the rapidity of gall formation. If there is no growth of tree there is little or no development of gall. *Inoculation late in the fall often will not develop until active growth the following spring.* May not this retarded development of the disease account for the large amount of gall that sometimes develops on young orchard trees from stock that was carefully inspected and appeared to be perfectly free from crown gall?

AVENUES OF ENTRANCE.

Crown gall infection must start from soil containing the disease-producing organism. There can be little doubt but that the soils of California are often naturally infected with crown gall. This is especially true of those that were formerly wooded or have previously grown stone fruits, especially if the latter were on peach roots that were infected with gall.

Little is actually known as to how actively the disease spreads under nursery irrigation. The fact that irrigation increases the amount of crown gall would suggest that the disease is possibly spread in this way.

On vigorous growing seedlings like almonds, there is often a scar directly beneath where the seed is attached that would be a most favorable place for gall infections. Almond seedlings also sometimes show small checks or cracks in the surface bark. The gall usually appears at the crown and very close to where the seed was formerly attached. Some experimental work is in progress in treating pits before planting with a thick paste of Bordeaux mixture with the hopes that possibly this will sterilize a small area of soil immediately surrounding the pit and so possibly prevent this early infection of the tree. These experiments, however, did not lessen the amount of gall as compared with other check trees.

Any injury to the trunk or root in the nursery or in digging the trees would be a favorable point for infection. The organism is entirely a wound parasite and could gain entrance in any mechanical injury, animal or insect bites.

HOSTS.

The following is a list of plants upon which crown gall has been found to occur naturally: Apple, apricot, almond, *Arbutus unedo*, alfalfa, beet, clematis (wild), clover (red), cherry, chestnut, cotton, daisy (Paris) or marguerite, grape, hop, honeysuckle, loganberry, peach, pepper tree, plum, prune, pear, parsnip, pecan, quince, raspberry, rose, salsify, sterculia, Victoria bottle tree, turnip, willow, English walnut, California black walnut, eastern walnut.

Galls have been artificially produced on the following in addition to those named above: Catalina cherry, eucalyptus, citrus, sweet orange, sour orange, lemon, lime, Angiers quince, Japanese walnut, butternut, a large number of different species of cultivated and wild plums, including the following: *Prunus cerasifera*, *P. Americana*, *P. triflora*, *P. domestica* (some of these varieties are quite resistant); *P. amygdalus*, *P. Armenica*, *P. avium*, *P. davidiana*, *P. hortulana* (wild goose), *P. Alleghenensis*, *P. Simonii*, *P. platycarpa*, *P. myra*, *P. eriogyna*.

DISEASE IN THE NURSERY.

The disease is extremely common in the nursery. Peach on almond rootstock is largely used, as the pits are easily and cheaply secured and the root is well adapted to the various stone fruits. The amount of the disease varies from year to year, being sometimes as great as 75 per cent. The Myrobalan plum is also a very popular stock on the Pacific coast and is freer from gall in the nursery than the peach or almond. There is no doubt that much of the disease among orchard trees has its origin in the nursery, from which it is distributed over a great range of territory. In California and other states where there is rigid inspection of trees and plants, any showing these galls are rejected, but often the infection has already taken place, but has not sufficiently developed to show, and so passes inspection only to develop on the young growing trees.

The injurious effects of the disease vary on the different kinds of trees, some readily succumbing to the disease, while others are more resistant and may live and be quite productive for years.

INFECTION AMONG ORCHARD TREES.

Apple trees are quite subject to crown gall, especially at the point where they have been bench-grafted. Here a gall often develops to considerable size in addition to the healing callous. The infection enters the injury from the soil. Budded or field-grafted trees, although more expensive, are much superior for planting, as they are always freer from crown gall. The hard and the soft forms of galls in apples have a similar cause. The hard form is of slower growth and probably not so injurious. Another form of apple disease supposed to have a cause similar to crown gall is the hairy root disease. This disease is characterized by an increased and abnormal production of fine roots that differ from the normal fibrous ones. These abnormal roots can usually be traced back to an irregular swelling or knot on the root. From these warty knots a rapid-growing succulent root develops that by intricate branching develops into a great mass of fine roots. Sometimes there is a broom-like formation of fine roots that occurs at the end of a side root that otherwise seems to be healthy. In general, the hairy roots are more fleshy and numerous than normal roots. Some stages of the disease are not accompanied by typical galls on the roots, but have small enlargements of the tissue at the base of the clustered hairy roots. While this form of gall differs manifestly from the other one described, it has been found to be caused by a bacterial organism closely allied if not identical with the one causing the spherical galls. There is some difference of opinion as to the seriousness of crown gall on apple, some authorities claiming it does not injure the bearing properties, while others claim a stunted and short-lived tree.

Pears are occasionally diseased with crown gall and the pear stock in common use, *Prunus communis*, as well as the varieties so far tested, readily take the disease. Not much is known as to how common or serious the disease is in pears.

Cherry stock is somewhat more resistant than peach or roots of the other stone fruits. The Mazzard and Mahaleb roots when tested became infected, yet the former variety showed considerable resistance. The

disease only rarely caused serious trouble in the cherry orchards, although a few cases have been observed where the disease was especially virulent.

Plums, peaches, almonds and apricots are often severely diseased. Different varieties of peaches, Muir, Salway and Lovell, have been arti-

FIG. 72.—Peach limb artificially inoculated with the crown gall organism February 15, 1912. Photographed February, 1916. (Original.)

ficially infected, as well as the different varieties of almond that are used as rootstocks. Much more resistance is shown among plums, especially the German prune and Damson, while the Myrobalan, which is a popular rootstock, is more readily infected. Orchards of peach and almond often show a high percentage of diseased trees, and there is little chance of a badly infected tree outgrowing the disease.

The English walnut is susceptible to the disease when on English roots, as much as 50 per cent of nursery trees being sometimes affected.

Galls are not so often found on the black root, *Juglans californica*, which is now used as a rootstock for the grafted varieties of English walnut. The disease on the walnut first causes the formation of a gall, which later decays and leaves the tree with the appearance of being eaten off at or below the surface of the ground. Black walnuts and English walnuts have been artificially inoculated.

The pecan has been found having the crown gall and has been artificially inoculated from pure cultures. Just how serious the disease may be in the pecan is not known as the tree is not commercially grown in California.

Quinces as grown in California have an aerial form of the gall, called black knot. This has been proven by Dr. Erwin F. Smith to be caused by a bacterial organism that is probably identical with that of crown gall as found on other trees. The disease, in most cases, does not seriously affect the tree, although hardly a quince tree in California is free from it.

CONTROL.

The control of crown gall will be briefly considered under the following: (1) Resistant stock as shown by artificial inoculation experiments on different species and varieties of *Prunus*; (2) Careful inspection of the tree before planting, followed up for a time by yearly inspection; (3) Sterilization of roots of small trees before planting with a germicide; (4) Tree surgery.

Stock Resistance.

Grow, if possible, stock having some natural resistance to crown gall. Grape stocks are often diseased. The European varieties are more susceptible than the American species. It has been shown by Dr. Geo. G. Hedgcock[1] that the Rupestris St. George variety shows resistance to crown gall as well as resistance to phylloxera. He also shows certain varieties of apples, such as Northern Spy, Ben Davis and Yellow Bellflower, to be strongly resistant to crown gall and hairy root disease.

Much attention has been given to the study of resistance in stocks that should be adapted to the various stone fruits. The plan has been to actually inoculate the various sorts of stock under experimentation with pure culture of the crown gall organism. At the end of the growing season a record was made of the percentage of gall that developed. While one season was usually sufficient, it was occasionally necessary to make another observation the following year.

The following paragraphs summarize this work and show the percentage of successful infections on several of the different species and varieties studied:

Degree of Resistance.

Apricots: *Prunus Armenica* (Mikado), 27 per cent; *P. dasycarpa* (purple), 40 per cent; *P. Mandschurica* (Chinese), 12 per cent; *P. Mume* (Japanese), 91 per cent; *P. Armenica* (Royal), 97 per cent; miscellaneous (California varieties), 60 to 90 per cent.

[1]Field studies of the crown gall and hairy root of the apple, Bulletin 186, Bureau of Plant Industry; Field Studies of the crown gall of the grape, Bulletin 183, Bureau of Plant Industry, United States Department of Agriculture.

PEACHES: *Prunus Mira* (Wild Chinese), 10 per cent; *P. Persica* (Muir), 85 per cent; Salway, 90 per cent; Elberta, 94 per cent.

ALMONDS: *Amygdalus communis* (bitter), 85 per cent; *A. davidiana* (Chinese), 88 per cent; *A. communis* (sweet), 95 per cent; miscellaneous (sweet varieties), 80 to 90 per cent.

PLUMS: *Prunus pumila* (sand plum), 0 per cent; *P. domestica* (Italian prune), 7 per cent; *P. insititia* (Purple Duane stock), 7 per cent; *P. domestica* (German prune), 10 per cent; *P. insititia* (Damson), 10 per cent; *P. domestica* (Green Gage), 25 per cent; *P. cerasifera* (hybrid) (Mariana), 85 per cent; *P. triflora* (Burbank), 90 per cent; *P. munsoniana* (Wild Goose), 92 per cent; *P. cerasifera* (Myrobalan), 95 per cent; *P. triflora* (hybrid) (Wickson), 98 per cent; *P. Simonii* (Simon), 99 per cent.

Other Stocks.

A large number of native species of plum are to be found in the United States, many of which are suitable for stock of the stone fruits. Among these are several types of hybrids that are vigorous and have been used in certain sections as stock. There are also European, Chinese and Siberian species of *Prunus* that may be excellent for stone fruits. In California there are three or four wild species of *Prunus* that may be adapted for certain sections and certain fruits. One of these is the California wild plum, *Prunus subcordata,* var., *Kelloggii* or Sisson plum, found growing near Mt. Shasta. Then there is the desert apricot, *P. eriogyna,* growing on the very edge of the desert. This is a bush, rarely a tree, from 6 to 12 feet high. The seedlings resemble the cultivated apricot somewhat in appearance of leaf. The pits germinate quickly, 10 to 15 days, and if sown early in the spring they would not require layering. In general appearance and size the pits are quite similar to those of Myrobalan. A strong growing tap root is quickly developed. It is not known whether this species will easily transplant or how well it is adapted to the various stone fruits. It is closely related botanically to the apricot and apricots have been successfully grafted on it.

The desert almond, *P. fasciculata,* is native over a considerable area of southern California. It is a small, slightly thorny shrub, 3 to 6 feet high. Pits small, irregular in shape, thin walled, smooth with sharp ridges.

The Texas almond, *P. minutiflora,* maximum growth about 12 feet, is found entirely in Texas and is often badly infected with crown gall. Then there is a Mexican almond, *P. microphylla,* which closely resembles the Texas almond. These would doubtless be adapted to the peach and almond but might not show much advantage over those we already grow. They have strong developed tap roots and are found wild in desert localities.

Field Inspection.

Carefully discard all diseased trees, even if some have to be sacrificed that have only small galls present. If the inspector does not throw out the diseased trees the grower should do so. The following spring the young trees should be carefully examined by digging away the earth about the crown down to the roots. If the trunk shows any evidence of gall formation, the tree should be marked, either to be replaced by a

new tree or treated. Do not try to treat badly infected small trees. It is more expensive than to purchase a healthy tree. A tree after the end of the first year is not so likely ever to contract gall, although it would be well to again inspect the trees at the end of the second season. When a tree is replanted where one has been diseased, care should be taken to use fresh earth in filling in around the tree.

The treated tree should be marked and examined again, for often the first treatment is not entirely effective and the galls may again begin to appear at the treated margins. If such is the case, the tree should be again treated. The individual judgment of the operator must be used as to whether the small tree had best be replanted or treated. If one begins with the small orchard and is willing to give careful attention to this trouble there should be no difficulty in keeping the crown of the tree free from gall. The root one can not expect to treat. It would be better not to take too much risk in treating badly-galled trees of one year's growth in the orchard, as it is very questionable if such will ever become profitable commercial trees.

Use Clean Ground.

If resistant stock can be secured, it should be used in preference to equally as good but susceptible stock. The importance of growing nursery stock in soil free from crown gall infection is becoming more and more recognized by nurserymen. The growers also are demanding such stock and sometimes going to considerable trouble and expense to find nurseries free from gall infection. At present there is no way of easily locating such nurseries except by a personal visit at tree digging time.

Next in importance to having clean stock is to plant in ground free from natural infection. There is good reason to think that certain of our native trees and shrubs may be sometimes diseased with crown gall. If this is the case, these abnormal growths can often be detected when the land is cleared. Old orchards of stone fruit trees are sometimes removed and again replanted to stone fruits. There is always danger of these old trees being infected.

It would be safer to wait for two or three years before replanting stone fruit trees in soil recently cleared from diseased trees. Citrus, the olive, or other resistant trees could be planted at once. In the meanwhile, the ground could be used for any of the annual crops, but not for alfalfa, as this plant is susceptible to crown gall and would probably further infect the soil.

Germicides.

The experiments in using germicides on peach roots have not given satisfactory results. The amount of gall lessened by the treatment was not sufficient to justify its use. There was always injury to the trees when the germicide was of sufficient strength to protect the tree from infection. In the experiments, Bordeaux paste, as recommended for lemon gummosis, was used, also Bordeaux mixture of the following strengths: 4-6-50, 12-15-50. Concentrated Ortho lime-sulphur and the two following strengths of 1-10 and 1-20 were tested. The concentrated solution killed all treated trees, the weaker strengths did not so markedly injure the tree as did the Bordeaux solutions, but their beneficial effects were slight. At present there is no chemical solution that can be recommended.

Surgery.

Tree surgery has been occasionally successfully used in treating orchard trees. Its use is, however, limited to the crown and upper roots of the tree. The work requires considerable care to be efficient. The discouraging part of the work is that the gall sometimes grows again at the margin of the treated area, when a second treatment is necessary. A good germicide should be used on the treated surface. A commercial preparation known as Warnock tree paint has been used with good results on large trees. It can not be safely used on young

FIG. 73.—Tools useful in tree surgery. These can be used in removing the dirt from the base of the tree and in cutting out the infected tissue. (Original.)

trees without injury, nor is it advisable to apply it to any large area of the bark of the treated tree. A good germicide to use in tree surgery work is Bordeaux paste which, as recommended by Professor H. S. Fawcett, is made as follows:

BORDEAUX PASTE: Twelve pounds of bluestone (copper sulphate) dissolved in 8 gallons of water in a wooden, earthen or glass vessel; and 24 pounds of quick lime slaked in 8 gallons of water. When the lime is cool, stir together about equal parts by volume of each for making enough mixture to last for one day only. The bluestone is easiest dissolved by suspending it in a sack at the top of the water overnight. If the bluestone is pulverized and suspended in warm water it dissolves rapidly. Good lime that is not air-slaked should be used, and after

slaking it with the water it should be allowed to cool before being used in making paste. If covered to avoid evaporation, each ingredient will keep indefinitely, but, after mixing, the paste slowly deteriorates. Where it is being used over a number of days or weeks, just enough of the wet slaked lime and the bluestone solution should be mixed to make paste enough to last for one day, leaving the remainder unmixed in separate vessels. It may be applied with large brushes, as is whitewash.

Conclusions.

The control of crown gall may be summarized as follows:

(1) Resistant stock is the most satisfactory treatment for this trouble. The experimental work at present is of necessity incomplete, but certain of the more resistant stocks will doubtless soon be available. These will be found for the most part among the Domestica and Damson plums. *P. pumila* has not been sufficiently tested to know its real merits as a stock, but it will doubtless dwarf the tree more or less and should only be grown in an experimental way for the present. The so-called Duane Purple stock has been grown in commercial orchards and should be farther tested under various soil and climatic conditions.

(2) Inspection of trees before and after planting is important and should be rigidly employed. Clean stock planted in ground free from infection is to be strongly recommended.

(3) Tree surgery will never be of general application, as it is expensive in time, labor and patience and will not appeal to the average grower.

CALIFORNIA CERTIFIED SEED POTATOES.

By W. V. Shear, Secretary of the West Coast Potato Association and Assistant Horticulturist, United States Department of Agriculture.

Last year certified seed potatoes were grown for the first time in California. Between 2,000 and 3,000 sacks were produced and will be planted the coming season, mostly to grow more certified seed. Besides these, several cars of certified seed potatoes have come into the state from other states. The movement for the production of good seed potatoes in California is, therefore, well under way. Owing to the necessary care in the production of this stock, last year a marked improvement was made over the seed stock previously grown in this state, and it has elicited much praise from those who have been able to secure a portion of it for this season's planting. However, since the methods of production of certified seed are comparatively little known, as yet, throughout the state, and since there is naturally considerable misunderstanding regarding its production in different localities and its value under all circumstances, it may be well to mention a few of the important phases of this industry.

The certified seed law is a *standardization* law it establishes a standard for this product and determines what qualifications potatoes must have to be sold as California certified seed. It therefore has little to say about *how* these potatoes shall be grown, but says considerable about what they must be after they are grown. It does not state what kind or what quality of potatoes shall be used for seed to

grow certified stock; it does not say how they shall be planted, or irrigated, or cultivated or fertilized. It deals with results of production rather than methods of production. However, the law was established because of the demand for good seed and the necessity for having it in order to grow good crops. It is very desirable, therefore, that those who wish to produce certified seed should plant that kind of seed if it can be obtained. If it can not be obtained, then the grower must do the best he can with what he is able to get. At this late season of the year there is very little, if any, certified seed to be obtained.

While there is no command in the law to dip seed for scab and rhizoctonia, with the majority of seed stocks this is a very important procedure if these diseases are to be kept in check sufficiently to produce stock that will pass for certified seed. Since these diseases are so very common, the law permits a light infection of these diseases in certified seed; and where certified seed is used it may be desirable to treat it with corrosive sublimate or formaldehyde solution. The very high cost of corrosive sublimate at the present time may make it almost prohibitive, and where the rhizoctonia infection is very slight the formaldehyde solution may be substituted.

INSPECTION.

In order that potatoes may measure up to the standard of certified seed, it is not sufficient to inspect them after they have been harvested and ready for shipment. The old adage that "you can not tell from the looks of a frog how far it can jump" applies in this case. Three inspections of the crop are necessary: when the plants are in bloom to determine mixture and disease infection; when they are almost mature to determine disease infection and productiveness; and after harvest to determine disease infection, uniformity and grading. The cost of these inspections is put upon the grower and may vary from three to ten dollars per acre, depending upon the acreage in any particular locality.

VARIATIONS IN CERTIFIED SEED.

Certain small amounts of the most common fungous diseases are permissible. Not over 5 per cent light infection of scab or 10 per cent light infection of rhizoctonia, or 8 per cent light infection of wilt disease may be permitted. These diseases are so common and difficult to eradicate entirely that it would be very difficult to secure much, if any, seed without some infection of one or more of these diseases, and under the circumstances this is a high standard. It is evidently impossible for the inspector to supervise the grading of every sack of certified seed. It therefore becomes incumbent upon the grower, after being informed as to just what the standard is, to see that his pack is kept up to this standard, and he becomes responsible for any infringement of the law.

RELATIVE SEED VALUES IN CERTIFIED SEED POTATOES.

It may seem to many that all certified seed potatoes must have the same value for seed purposes regardless of where they are grown or where they are planted. However, this is by no means the case. The State of California comprises a very great variety of soil and climatic conditions—as varied as that of the whole Atlantic coast. We have

localities comparable to the climate of Florida and also to that of northern Maine, and it is a well known fact that seed potatoes from Florida differ in value from seed potatoes grown in northern Maine. This is evidenced from the fact that seed stock from northern Maine is shipped to points throughout the Atlantic seaboard and even into Texas. Potatoes normally thrive best in cool, short season, temperate climates; and seed stocks taken from such localities will grow faster and produce earlier crops than seed grown in localities where the climate is warmer. Therefore, where earliness is a factor in securing better prices for the crop, as is usually the case in early potato-growing sections, it is advisable to use for part of the crop seed which has been grown far north or at a high altitude. It is a common belief that potatoes will "run out" when planted year after year in the same locality. This is doubtless true where no attempt is made at selection of the best hills, and is especially true in warm localities where it is difficult to carry potatoes over from one year to the next. Potatoes will retain their vigor for a greater number of years in a cold, rigorous climate than in a mild or warm climate.

Seed potatoes also require quite a long period of rest or dormancy after being harvested before they will naturally germinate and produce a new crop. It is because of this fact that growers who desire to produce two crops in a single year often have difficulty in securing a stand by planting early-crop seed for a fall crop. Not only does a considerable portion of the seed fail to germinate, but the yield from the plants which do grow is usually considerably smaller than where the seed has had an opportunity to "rest" for several months.

People who use certified seed potatoes must, therefore, understand their local conditions and secure such seed as will meet the requirements of their own peculiar circumstances to best advantage. It must not be taken for granted that, because seed potatoes are "certified," no further thought need be taken to secure such stocks as will meet the particular needs of a particular locality.

THE CAUSES OF UNNECESSARY DECAY IN LEMONS.*

By R. L. WILLITS of Corona, California.

The work wherein the causes of unnecessary decay in the lemon may occur can be divided into three heads: the growing, picking and packing. No one can hope to establish a reputation in the markets of this country for firm, good-keeping lemons if there be lack of care in any of the three branches of this work. It has been fully demonstrated to the satisfaction of the shippers of the packs that bring full prices that the trade is willing to pay a good price for careful, intelligent and consistent work, and it has also been demonstrated to the dissatisfaction perhaps of the careless ones that poor work will be discounted, so that it is more expensive in the end than good, careful work.

When all the operations employed in the growing, picking and packing of lemons are organized, and checking methods put into practice so that the responsibility for every part of the work is definitely fixed, the

*Address before State Fruit Growers' Convention, San Bernardino, California, February, 1916.

results show that careful work is usually done cheaper than where less careful work is permitted. The fact that careful work is usually cheaper is accounted for by reason of better organization, each employee feeling a certain responsibility for the work he is performing.

The cultural problems that confront the grower who is trying to produce good-keeping lemons are more numerous and harder to solve, perhaps, than those that are met in the other two departments. No one has demonstrated that all lemons can be grown up to size while they are still green, but intelligent effort to come as near as possible to this optimum is well paid for. Cultural methods that will keep the foliage dark green and the trees growing and free from gum disease, scale and other parasites will produce the largest proportion of green lemons that are up to size, and any grower who fails to do whatever is necessary to maintain this condition is increasing the per cent of decay by neglecting his part of the work, as well as the foreman who permits rough handling.

Brown rot was at one time one of the most alarming causes of decay, but with the help of the State University and some of the most progressive growers well defined methods for the prevention of this loss have been worked out; for instance, the covering of the ground under the tree and out beyond the drip of the branches with some kind of a mulch, or the spraying of the lower branches and the ground with Bordeaux. The latter method is considered the most effectual, and if the trunk of the tree is wet with the spray at the same time, this will help protect against possible infection of the bark by brown rot which causes gum disease. The Bordeaux dries on the fruit and leaves a coating, which protects against infection. The comparatively small amount of Bordeaux that is sprayed on the ground would have little effect in killing all the brown rot that is present in the soil of badly infested orchards, as it has been found scattered through the soil to a depth of four feet; but when the brown rot attempts to grow to the surface of the ground, a very large part of it is killed by coming in contact with the Bordeaux.

A good cover crop also acts as a check to the spread of the brown rot spores, in that it forms a covering over the ground, and the spores are not so apt to rise up through a thick growing crop and get on the trees. However, a heavy cover crop creates an ideal condition in wet weather for the propagation of another form of decay, commonly known as "cottony rot" or "white mould." This fungus is carried over from one wet season to another in the soil by the sclerotia, or small black bodies that develop in the cottony growth. During wet periods the sclerotia send a growth to the surface of the ground which produce cup-shaped discs in which the spores are produced in microscopic sacs. At the end of the sacs the growth upon drying breaks apart, and the spores are ejected into the air. The sacs are so sensitive that even blowing the breath over them will cause the outer end to break and a cloud of spores to rise into the air.

I have seen trees where a large part of the young lemons and bloom was destroyed by cottony rot. It does not often attack the larger fruit, but when this form of decay gets started in a box of lemons, it soon takes all the fruit in the box, if not discovered in time. There are some kinds of cover crop in which it seems to thrive better than others. It can be found more abundant, perhaps, in vetch than in any other

cover crop in common use, while *Melilotus indica*, being an upright growing plant, offers less opportunity for the growth of this fungus.

Mr. C. O. Smith of the State Pathological Laboratory at Whittier has done a great deal of work investigating this form of decay, and has prepared a bulletin on the subject, which will, no doubt, be available soon, and which I am sure will be of interest to all lemon growers.

Brown centers, so called, have caused a great deal of loss, especially during the last two seasons, and so far we have been unable to place this loss in the avoidable decay column, but Dr. Webber and his assistants are at work on this problem, and we expect to know more about the cause and control of this decay soon.

A great deal has been said about the different classes of labor employed in picking, and no doubt the good or bad standing the different classes of pickers have is very largely due to the kind of supervision exercised. The right picking foreman will get good results from almost any of the different classes of help that are available. If a regular inspection of each picker's work is maintained, any poor work is soon discovered, and if the inspections are properly followed up, decay that results from long stems, clipper cuts, and scratches from thorns and dead brush can be greatly reduced, but the responsibility for the work must be definitely fixed in order to get best results.

The damage caused by rough handling in the field is not easily detected by inspecting the fruit in the packing house, unless a very careful and minute examination is made of each lemon. Rough handling should be guarded against by the foreman on the ground, and he, in turn, should be regularly checked up. It is very important that great care should be exercised in the handling of lemons. They should never be dropped any distance at all, not even an inch. The importance of this may be demonstrated by taking a lemon and dropping it about two inches onto a dry board, and if it is dropped so that it falls on the point, a moist spot will appear on the board, showing the lemon has been damaged.

The picking bag should not be too large. A bag that will hold about twenty-five pounds of fruit is used by some of the most careful concerns, and the opening in the bag should be so arranged that the picker's hand will have to put the lemon in the bag, instead of dropping it into the opening. A wide, open-topped bag will catch more small bits of dead branches and the short pieces of stem that come from making the second cut.

The clippers should be carefully gone over to make sure they are sharp enough to make a clean cut. Sometimes the blades get sprung apart so that they leave a small sliver of the woody part of the stem. This will cause more damage than a long stem, as it is so sharp that it cuts into every lemon it touches.

Great loss by decay has been caused by permitting picked lemons to remain in the grove during a rain where the soil is badly infested with brown or cottony rot.

One of the most common mistakes in handling the boxes on and off the wagons is to allow a box to drop off the cleat at one end of the box below and come down on the lemons, and then be pulled across before being picked up.

We use low, narrow wagons that are easily loaded and can be taken into the groves with little damage to the trees, and the lemons are taken directly to the packing house on these wagons, with but the one handling.

It is very important that the picking should be done at the right time, and the interval between pickings should be varied to suit the weather conditions at different times of the year. During the time of year when rains are apt to occur a special effort should be made to have the picking closely kept up.

Some growers have an idea that it pays to let the lemons grow large in order to get greater quantity, but this is usually an economic waste, both in the growing and marketing, for the energy of the tree is expended in growing fruit that is of poorer keeping quality than that which is picked when the proper size, and it is also an off size that is not wanted, being sold at a discount. Pooling arrangements should pass this loss on to the grower who is responsible.

It is a mistake to leave small yellow ripe lemons on the tree, trying to force them up to the regular size at the expense of keeping quality; a small lemon that will keep may be worth something, but a full-sized lemon that will not is a liability.

I want to again emphasize the fact that all parts of the work should be so organized, that if anything occurs that tends to increase the decay of the fruit the blame can be immediately placed where it belongs.

CROP REPORT AND STATISTICS.

MONTHLY CROP REPORT.

(June 3, 1916.)

By Geo. P. Weldon.

Compiled from the reports of the County Horticultural Commissioners.

County	Almonds (per cent)	Apples (per cent)	Apricots (per cent)	Berries (per cent)	Cherries (per cent)	Figs (per cent)	Grapefruit (per cent)	Lemons (per cent)	Olives (per cent)	Oranges (per cent)	Peaches (per cent)	Pears (per cent)	Plums (per cent)	Prunes (per cent)	Walnuts (per cent)
Alameda	65	#	60	90	10	#	#	#	#	#	#	80	—	30	#
Butte	20	90	10	#	50	75	#	#	—	—	25	—	35	35	#
Colusa	75	#	75	#	#	—	#	#	#	100	75	75	#	75	100
Contra Costa	60	90	45	#	20	—	#	#	—	—	80	65	70	50	100
El Dorado	#	65	#	#	30	#	#	#	#	#	70	40	40	30	#
Fresno	100	#	25	100	#	100	#	100	100	100	50	#	#	#	#
Glenn	75	50	75	100	75	50	100	100	100	100	90	100	#	70	85
Humboldt	#	90	#	80	90	#	#	#	#	#	—	90	—	—	—
Imperial	#	#	60	#	#		#	#		#	#		#	#	#
Kern	#	60	75	#	#	100	#	#	100	100	85	60	90	100	#
Kings	#	#	50	#	#	#	#	#	#	#	90	#	#	100	#
Lake	50	50	25	75	50	50	#	#	—	#	50	25	#	25	50
Lassen	#	5	0	50	0	#	#	#	#	#	0	0	0	0	#
Los Angeles	80	100	30	100	#	50	100	100	80	100	100	50	30	#	70
Madera	35	—	30	#	#	60	#	#	100	#	80	#		85	#
Mendocino	60	100	50	50	80	#	#	#	#	#	75	30	#	75	#
Merced	90	#	50	100	#	100	#	#	100	#	70	#	#	#	#
Modoc	#	60	10		10	#	#	#	#	#	10	25	10	10	#
Monterey	50	65	30	50	25	#	#	#	#	#	75	50	25	—	#
Napa	#	80	25	100	30	#	#	#	#	#	60	50	80	40	#
Nevada	50	100	90	50	40	50	#	#	—	—	100	60	40	40	20
Orange	#	100	0	100	—	—	100	100	100	110	75	—	100	—	100
Placer	25	100	40	90	35	90	#	—	—	90	75	75	80	#	#
Riverside	90	75	20	#	50	#	100	90	80	75	80	40	#	75	50
Sacramento	65	90	85	100	85	#	—	—	100	—	70	68	65	50	#
San Benito*	100	100	40	—	50	#	#	#	#	#	85	100	#	50	#
San Bernardino	#	50	15	#	90	#	100	95	80	100	50	50	80	80	100
San Diego	70	25	10	100	0	—	100	75	100	100	80	20	25	20	—
San Joaquin	40	80	25	#	25	#	#	#	#	#	75	50	75	50	75
San Luis Obispo	100	90	50	#	100	#	#	#	#	#	90	80	#	95	80
Santa Barbara	#	100	50	#	100	#	100	100	100	100	#	90	#	#	50
Santa Clara	#	60	50	—	10	#	#	#	#	#	75	50	—	50	#
Santa Cruz	#	80	25	75	25	#	#	80	#	#	75	50	—	40	#
Shasta	20	80	5	50	5	75	#	#	100	#	60	25	50	60	75
Siskiyou	0	10	0	50	5	#	#	#	#	#	5	5	5	5	0
Solano†	#	#	25			#	#	#	#	#		75	75	75	#
Sonoma	25	75	—	65	25	—		#		#	80	80	50	35	90
Stanislaus	80	75	20	100	100	50	—	#	—	#	85	80	100	100	#
Sutter	75	100	80	—	100	100	#	#	75	#	85	50	75	75	#
Tehama	100	25	50	50	75	—	#	#	60	—	65	75	—	75	#
Tulare	#	100	30	100	#	—	—	—	—	—	90	#	75	95	#
Ventura	—	—	40	—	—	—	—	100	—	90	#	#	#	—	65
Yolo	65	#	40		#	—	#	#	—	#	75	80	90	50	#
Yuba	70	90	40	70	#	90	100	100	60	100	60	75	75	60	#

Figures in table indicate condition of crop in per cent, on the basis of 100 as normal.
— Horticultural commissioner has insufficient information for a report.
Not grown commercially.
† No commissioner in county. Report received from Farm Adviser.
* No report received since May 1st.

Grapes.

County	Raisin (per cent)	Table (per cent)	Wine (per cent)	County	Raisin (per cent)	Table (per cent)	Wine (per cent)
Alameda			25	Placer	33	33	33
Butte	50	50	#	Riverside	#	90	90
Colusa	75	75	#	Sacramento	25	25	25
Contra Costa	#	—	70	San Benito			
El Dorado				San Bernardino	100	100	100
Fresno	100	100	100	San Diego	100	100	100
Glenn	90	85	#	San Joaquin	#	70	70
Humboldt	#	#	#	San Luis Obispo	#	#	#
Imperial		100		Santa Barbara	#	#	#
Inyo				Santa Clara	#	#	—
Kern	100	100	100	Santa Cruz	#	50	50
Kings	100	100	#	Shasta	75	75	75
Lake	#	#	20	Siskiyou		0	
Los Angeles	100	100	100	Solano*			50
Madera	100	100	100	Sonoma			50
Mendocino				Stanislaus	#	#	#
Merced	100	100	100	Sutter	100	100	100
Modoc				Tehama	#	#	#
Monterey	#	—	—	Tulare	—	—	—
Napa			35	Ventura	—	#	—
Nevada	#	90	90	Yolo	80	80	80
Orange	—	—	—	Yuba	75	75	75

Figures in table indicate condition of crop in per cent, on the basis of 100 as normal.
— Horticultural commissioner has insufficient information for a report.
Not grown commercially.
* No horticultural commissioner.

STATISTICS.

Estimated per cent of the total crop of the principal California fruits grown in each of the main producing counties during a season of normal production. Compiled from the reports of the county horticultural commissioners.

County	Almonds (per cent)	Apples (per cent)	Apricots (per cent)	Cherries (per cent)	Figs (per cent)	Lemons (per cent)	Olives (per cent)	Oranges (per cent)	Peaches (per cent)	Pears (per cent)	Plums (per cent)	Prunes (per cent)	Walnuts (per cent)
Alameda	*		14	9						2	*	*	
Butte	12	*		*	3	*	14	*	3	2	*	2	
Colusa	4		*						*	*		*	
Contra Costa	11	*	*	*					*	6	*	*	
El Dorado		*		*					*	3	*		
Fresno			5		53		3	*	29			*	
Glenn	*		*								*		
Humboldt		2											
Imperial			*		*								
Inyo		*							*				
Kern		*	*					*	*	*	*	*	
Kings			5						6			*	
Lake	*	*	*						*	8		*	
Los Angeles	2	2	4		*	31	14	26	4	*	3	*	30
Madera	*	*	*		3		2		*			*	
Mendocino		*								*		*	
Merced	*		*		9		*		3				
Modoc													
Monterey	*	12	2	*						*			
Napa	*	*	*	*	*		*		*	4	*	4	
Nevada		3	*	*					*	*	*		
Orange			4			7		10					38
Placer	*	*		3	*		*		6	7	39		
Riverside	3	*	7	*		16	11	14	*	*		*	
Sacramento	6		*	5			5	*	*	18	8	*	
San Benito	*		6	*					*	*	*	3	
San Bernardino		4	4	*		13	7	31	5				2
San Diego	*	*	*			10	5	*	*				
San Joaquin	12		2	25	*		4		8	4	*	*	
San Luis Obispo	*	*	*										
Santa Barbara		*	*	2		*	2						10
Santa Clara	*	*	21	26	*				5	9	18	55	
Santa Cruz		51	3	2					*			*	
Shasta	*	*					*		*	*		*	
Siskiyou		*											
Solano	6		8	10					3	6	16	4	
Sonoma	*	16	*	9	*		5		*	6	*	12	
Stanislaus	6		*	*	*			*	3	*			
Sutter	9				*		*		2	*	*	*	
Tehama	*	*	*		*		11	*	*	2	*	*	
Tulare	*		*		6	5	6	13	9		2	4	
Ventura			6			15		2					20
Yolo	11		5		5		3		2	9	4	2	
Yuba	*				2		3	*	*	*	*		

*Less than 2 per cent of State's normal crop grown in county.

THE MONTHLY BULLETIN

CALIFORNIA STATE COMMISSION OF HORTICULTURE.

DEVOTED TO HORTICULTURE IN ITS BROADEST SENSE, WITH SPECIAL REFERENCE TO PLANT DISEASES, INSECT PESTS, AND THEIR CONTROL.

Sent free to all citizens of the State of California. Offered in exchange for bulletins of the Federal Government and experiment stations, entomological and mycological journals, agricultural and horticultural papers, botanical and other publications of a similar nature.

A. J. COOK, State Commissioner of Horticulture ---------- Censor
E. J. VOSLER, Secretary State Commission of Horticulture ---------- Editor

ASSOCIATE EDITORS.

GEO. P. WELDON ---------- Chief Deputy Commissioner
HARRY S. SMITH ---------- Superintendent State Insectary
FREDERICK MASKEW ---------- Chief Deputy Quarantine Officer

Entered as second class matter December 29, 1911, at the post office at Sacramento, California, under the act of July 16, 1894.

Northwestern Fruit Exchange to use its influence toward preventing the shipment of wormy and scabby apples into California this fall.—The market for California apples packed by the Watsonville Apple Distributors last season, under the Standardization Act of 1915, was seriously crippled because of the shipment into this state of very poor grade, scabby, and almost worthless apples from Oregon and Washington. Because of this fact the following letter was sent to Mr. H. G. Fletcher, Manager of the Northwestern Fruit Exchange at Seattle, Washington:

NORTHWESTERN FRUIT EXCHANGE,
Stuart Building, Seattle, Washington.

GENTLEMEN: I wish to call your attention to the fact that the marketing of California apples, packed under a standardization act passed by the 1915 session of the legislature, was greatly injured by the shipment into California of exceedingly poor grade, scabby fruit from the Northwest last season. The Watsonville Apple Distributors, representing 80 per cent of the growers of a section which produces more than 50 per cent of the entire state's output of apples, packed all their best apples under state label, in accordance with the terms of the act. To them your shipments have meant little short of disaster, and if, each season, the Northwest were allowed to unload this kind of stuff onto us, our standardization law, which promises so much, would be of little value. That your people recognize the detrimental effect upon their own market, and the disastrous lowering of a standard which they have tried so hard to maintain, and that they do not countenance the practice of shipping scabby, worthless fruit, is indicated in the resolutions adopted by the North Yakima Association, a copy of which I am enclosing.

Can you not give us some assurance that the class of fruit allowed to come into California last season will be kept out in the future? Unless you can, California will be compelled to deal with the situation in a drastic manner, in order to protect the high standards of the legislative act of 1915.

Hoping to hear from you soon, and that you may be able to meet the situation there, so that action on the part of this state will not be necessary, I am,

Very truly yours,

STATE COMMISSION OF HORTICULTURE,
By (Sgd.) GEO. P. WELDON, *Chief Deputy and*
Acting State Commissioner of Horticulture.

In reply to the above, Mr. Fletcher wrote as follows:

PORTLAND, OREGON, May 23, 1916.

Mr. GEO. P. WELDON,
Acting State Commissioner of Horticulture,
Capitol Building, Sacramento, California.

DEAR SIR: Beg to acknowledge receipt of your favor under date of May 18th. I am attaching hereto copy of a bulletin which we have issued today to all of the shippers in the Northwest affiliated with the Northwestern Fruit Exchange. I am quite confident that it will not be necessary for you to take any drastic action on shipments made by those affiliated with this Exchange. Also, I am sure that our shippers in the different districts will be very glad to assist you and the growers of your state in any way possible to keep the apple markets of your state in the very best possible condition, and we realize that the only way this can be done is by placing on those markets fruits of marketable quality.

We feel confident that you intend to be thorough in your policing of these shipments, and that no partiality will be possible. It would work a serious hardship on our shippers if they are not permitted to make shipments of these scabby apples, especially to California markets, when some of their competitors are exercising this privilege.

Last season there were some experiments conducted by shipping wormy apples in crates. These experiments proved disastrous for the growers, shippers and everybody else, and there is no possibility that there will be a repetition of this experiment. I think the only fruit that the California authorities will have to watch for carefully will be scabby apples from some of the Oregon districts. The growers in the Hood River and Medford sections are making an heroic effort to eliminate this scab, and we are hopeful that they will be successful this season, but due to recent rains, just at the time when they should have been applying another spray for the scab, there is some possibility that they have not been able to check this disease entirely. We are trying to negotiate satisfactory disposition of any scabby fruit coming into the hands of our shippers for sale to by-products plants. We trust what we have done in answering your request for assistance is satisfactory. If you have any other suggestions to offer, we will appreciate them.

Very truly yours,

NORTHWESTERN FRUIT EXCHANGE,
By H. G. FLETCHER, *Sales Manager.*

In the bulletin which Mr. Fletcher mentions in his letter as being sent to the members of the Exchange, the following statement is made:

> "We do not anticipate that it will be necessary for the California Horticultural Commission to draft any state laws prohibiting the sale of such fruit in the California markets on account of any action by the shippers affiliated with the Northwestern Fruit Exchange in refusing to honor this request, but

that assistance will be rendered to the California commission and the shippers of that state by this Exchange and its affiliations in supporting the effort, which effort is certainly a worthy one.''—G. P. W.

Expert Advice.—One occasionally sees, in our various journals and newspapers, paragraphs devoted to the above topic, usually written in a vein of ridicule. Not that these reflect the attitude of the editors themselves, for there are no more ardent supporters of experimentation and research than these same papers. They do, however, reflect the opinions of a rapidly decreasing but still far too large proportion of our farmers. These paragraphs referred to usually appear in the shape of a letter and are presumably published with the idea of leavening somewhat the heavier and more profound portions of the journal. To the farmer who had the complaint to make, however, the difficulty was a real one, and it may safely be assumed that he had no intention of contributing anything humorous to the paper.

It is only too frequently true that the application of expert advice to specific farm problems by the farmers themselves fails to bring the desired result, but such failure should not by any means always be laid at the door of the *expert*. There are two sides to the question. As a general rule the expert can only get at the main principles, leaving the farmer to apply the information to his specific problem in the way which in his own judgment is best fitted to solve it. It must be remembered that in at least 90 per cent of the cases such advice is given from a distance by mail. Both for financial reasons and from lack of time it is impossible for the expert to investigate the problem in person. It is necessary to make his diagnosis and recommendation from a distance and to depend entirely upon the farmer's accuracy and completeness of observation for his data. No one would expect a reputable physician to prescribe for a case he has not examined personally, yet that is what the expert must nearly always do. Accurate data covering symptoms is just as important in the one case as in the other, the only difference being in the degree of danger should a mistake be made. It is quite as difficult to diagnose pathological troubles in plants as it is in human beings.

The success of the expert's recommendation is also entirely dependent upon the faithfulness with which the farmer carries out instructions. Frequently slack methods are employed in putting the remedy into practice, and it is usually these careless ones who are the first to complain of the failure of expert advice. This slackness is particularly evident in the application of remedies in the form of sprays for insects and fungous troubles. Sometimes poor ingredients are used or the emulsions improperly made. Sometimes the spray tank is left standing until the ingredients have settled, and as a consequence part of the material is used at many times its correct strength with resultant burning of foliage. Naturally the remedy fails, and away goes the farmer's confidence in experts.

Contrary to the opinion of many, experts are usually practical men. Success for them depends entirely upon their ability to make recommendations effective from a practical standpoint. Growers can safely depend upon it that when applying for expert advice a prescription will be given which is correct only in so far as the data

submitted by them is accurate and complete, and the success of the remedy will be in proportion to the accuracy and completeness of the data, together with the faithfulness with which the recommendations are carried out.—H. S. S.

Report of the Forty-seventh Convention of Fruit Growers—Owing to unavoidable circumstances, the report of the Forty-seventh Convention of Fruit Growers, which was promised us by a Los Angeles printing company early in May, has not been received, but should be ready for distribution before this bulletin goes to press. This and other reports are free to all citizens of the State of California and can be obtained by writing to the State Commission of Horticulture, Sacramento, or by calling at the office of your County Horticultural Commissioner, who will have a supply of the reports. That this report contains much valuable horticultural material is evidenced by the table of contents which follows.

Report Forty-seventh Convention of Fruit Growers.

—E. J. V.

Paint Large Pruning Cuts.—In nearly all of the old orchards we see many large trees which should be in their prime but unfortunately are nearly dead. If the pruning cuts of years ago had been made without leaving stubs, and properly cared for, many of these trees would now be yielding large crops. A closer examination will show the hearts of the large limbs and even the trunks decaying. This is caused by rot fungi which enter through large cuts left unprotected from the weather.

Every book on the culture of the apple, pear or other deciduous trees, recommends the painting of all large wounds. Authorities differ in the main as to the time of application and the material to be used. There are some very good men who recommend painting as soon as the cut is made. It is because many have followed this and have seen the effects that we hear so much talk of the evils of painting, and see examples on every hand of trees with large unhealed cuts left unprotected. If the owners of these trees would visit some nearby old orchard and notice the number of limbs and trunks with the hearts rotting out, I believe more interest would be shown in protecting our orchards from such conditions.

If a cut is painted at once after pruning, the sap will be held on the surface and will sour, often running from the wound and killing the bark for inches down. Of course this is worse than if the wound had not been painted. However, if the cut had been left exposed to the air for a few months, the wood would have become hardened by exposure and could safely have been painted without danger of the above mentioned undesirable result. This later painting will prevent any dry rot fungi from entering the limb. It seems most desirable to paint in May or June all cuts larger than a twenty-five cent piece, as by this time the wood is hard and as yet has not started to decay.

In painting pruning cuts it is not best to use a material that will become hard and chip off with the growth of the tree, for this reason never use white lead or paint as they are only temporary. Grafting wax is probably the best material to use. Roofing compound, asphaltum or even paraffine may be used quite successfully. In painting do not apply the wax or other material too thickly. All that is necessary is a thin film to keep the air from the wood. If it is put on too thick very often in the heat of summer it will run, injuring the bark.

The following is an excellent formula for grafting wax:

Resin	6 pounds
Beeswax	1 pound
Linseed oil	1 pint

Melt together and apply at a temperature of 180 degrees.—J. B. Hundley, County Horticultural Inspector, Yucaipa.

COUNTY HORTICULTURAL COMMISSIONERS' DEPARTMENT.

WIREWORM CONTROL.*

By J. N. French, County Horticultural Inspector, Oxnard, California.

INTRODUCTORY REMARKS.

Wireworm injury in the Oxnard district from a commercial standpoint is confined almost entirely to the beet and bean crops. Of these two the bean crop injury is the one that is causing any great anxiety among the farmers. The fact that nearly all the beets are planted early, thereby allowing them to get started before the worms commence working in the spring, accounts for this. Wireworm injury to beans, however, is a very serious matter. It is very hard to give any definite figures on injury, owing to the fact that most of this wireworm injury consists in the stunting of vines with the corresponding decrease in yield, rather than in taking the stand or in killing the young vines outright. One hundred thousand dollars is thought to be a conservative estimate on the damage done during the season of 1914. During the season of 1915, due to the warm weather which prevailed during the growing season and to the control work which was done, the injury was cut down 50 per cent, or about $50,000.00.

This wireworm injury was done for the most part by one species, *Limonius californicus,* although at least three other species were found associated with this one in some instances. The percentage of these other species, however, was very small.

Nothing can be more erratic, apparently, than the actions of the wireworm larvæ. In some cases they clean out the same place year after year; in other cases the infested area may move from one side of a field to the other or into another field, and in some instances the infestation seems to be bad in a certain field every other year. According to J. E. Graf (see Bureau of Entomology Bulletin 123), the worms stay in the ground approximately three years before changing to beetles. The first year they are so small they do practically no commercial damage; the second year they cause considerable trouble, and the third year they are at their worst. In the first case there are constantly recurring generations in the same place, in the second the worms hatch out in one place and the beetles, in search of the most suitable places to lay their eggs, go elsewhere. This explanation does not cover the third case, however. It is possible that this damage is done by some other species of wireworm with a shorter life cycle.

That old bean settings and fields which have been covered with manure are more subject to wireworm infestations is explained by the fact that they provide more suitable places for the beetles to hibernate and lay their eggs. The food scent of bean settings also has a tendency to attract worms from a considerable distance. The resulting concen-

*The following is a report on wireworm control work carried on in the Oxnard district during the past two years. It is hoped that the report may prove of value to the beet and bean farmers, as well as to the members of the commission.

The writer wishes to express appreciation for the many privileges extended to him and the encouragement given to this experimental work by Mr A. A. Brock, Ventura County Horticultural Commissioner.

Mr James Leonard, Donlon Bros and Johnson Bros. are named as colaborers with the writer in this work, and the results as stated may properly be termed the results of their collective labors.—J. N. F.

tration very often means a bad wireworm infestation. During the last two years which were unusually wet, the centers of infestation by wireworms seemed to move from the low country near the ocean to higher ground, in places where there was a choice. Before that, the centers of infestation had usually been in the low areas. If these observations are correct, we should look for the centers of infestation on the higher ground this year.

There seems to be considerable variation in the time the worms become active in the spring in the different types of soil and in different localities. During the spring of 1914, which was very cold and foggy, the worms did considerable damage in the Camarillo district and even as far inland as Somis. During the spring of 1915, which was unusually warm and sunshiny, practically no damage was done in the Camarillo and Somis sections, and considerably less damage than usual in the Oxnard district. On cold sandy ground, in some instances,

FIG. 74.—Wireworms, the larvæ of click-beetles, in a potato. Slightly enlarged. (After Essig, Inj. and Ben. Insects of Cal., p. 232, State Hort. Com.)

catch-crops failed to show any worms, but the beans were riddled when planted. In another instance the beans germinated and grew for several weeks before the worms became active. Soil temperature and to some extent the moisture content are undoubtedly the controlling factors in these cases. In fact, the worms seem to be very sensitive to heat. They will live indefinitely in cold water, or may live half an hour in pure distillate, but they are killed in five or ten minutes when exposed to the warm sunshine or placed in lukewarm water, and dropping them through raw steam kills them instantly.

These different conditions are confusing and lead to a vast number of erroneous ideas and conclusions on the part of the farmer. Many a farmer has been led to believe that he has controlled the worms through

some treatment or special cultural method employed, when in reality the disappearance of the worms was due solely to some natural influence. It is not only difficult to devise control measures that will prove effective in every case, but it is also hard sometimes to check up work and know that results are being obtained.

WORK AGAINST THE LARVAL STAGE.

Poisoned Baits and Deterrents.—Work with poisoned baits proved entirely unsatisfactory. The worms either ate the poisoned bait with no ill effects, or the bait proved distasteful and was not touched. Prominent among the first group are strychnine, bichloride of mercury, carbide, nicotine sulphate, tobacco extract, and several forms of arsenic. Paris green and sodium cyanide seem to have some value as deterrents, but have been discarded because they injure the germination of the bean. However, in these experiments it was found that sodium cyanide has other values, which will be considered next under the head of soil fumigation.

FIG. 75.—Adults of the sugar beet wireworm, *Limonius californicus* Mann. Natural size. (After Essig, Inj. and Ben. Insects of Cal., p. 233, State Hort. Com.)

Soil Fumigation.—During the spring of 1914, under the direction of Mr. R. S. Vaile and Mr. J. E. Graf, carbon bisulphide was used by means of a small pressure tank rigged up on a walking plow so as to throw a stream into the bottom of the furrow. In this way it was immediately covered up and a crosskill was then used to pack the top of the ground. The results of this experiment were entirely negative, and further experiments were given up on account of the cost of the material and the apparent lack of effectiveness. Cyanide was also used, being put in with a fertilizer drill at the rate of $25.00 per acre. This experiment was discontinued at the same time as the carbon bisulphide experiment and for similar reasons.

In experimenting with sodium cyanide (128-130 per cent) as a poisoned bait during the spring of 1915, it was noted that in every case the worms were dead, although apparently not having touched the bait. This led to the conclusion that they were killed by the action of the gas. A little additional work proved such to be the case. The writer then took the matter up with Donlon Bros., and they agreed to finance a trial in the field. In order to find the least amount of cyanide necessary

to kill, considerable preliminary work was done, first in cans, then in tubs and later in 2 by 5-foot plots in the open field. It was found that a very small dose of cyanide would do the work, provided it was put in the soil below the worms and the top of the ground packed to hold the gas. The kill in every case was slow, requiring from 3 to 7 days. In each case the cyanide was put in 8 inches deep in a single row in the center, running lengthwise with the plot, the ground being thoroughly tramped on top to hold the gas. In every case the only worms found alive were those along the outer edges of the plot and below the action of the cyanide. To get the percentages given below, all the worms found in a space 1 by 2 by 5 feet were counted. The following table summarizes the results obtained on the 2 by 5-foot plots in the open field:

Formula	Alive	Dead	Per cent
No. 1—1 oz. cyanide to 1 qt. water (10 cu. ft.)	15	200	93
No. 2—2 oz. cyanide to 1 qt. water (10 cu. ft.)	45	625	92
No. 3—3 oz. cyanide to 1 qt. water (10 cu. ft.)	84	1,430	94
No. 4—1 oz. powd. cyanide mixed with 1 qt. dry dirt (10 cu. ft.)	52	570	93
No. 5—2½ oz. powd. cyanide mixed with 1 qt. dry dirt (10 cu. ft.)	16	593	97
No. 6—5 oz. powd. cyanide mixed with 1 qt. dry dirt (10 cu. ft.)	20	558	96
No. 7—½ oz. powd. cyanide mixed with 1 qt. dry dirt (10 cu. ft.)	4	636	99

It will be noticed that there is practically no difference in the action of cyanide in solution and that used in the powdered form. At this point the liquid solution was discarded on account of presenting more difficulty in applying. There is comparatively little difference between the results obtained with the stronger doses and with the weaker ones. Experiment 7 was put in after the results of the first six were known, and the good results obtained were attributed to the fact that the ground was more thoroughly packed. All the preliminary experiments were carried on in a medium loam.

The following diagram will give an idea as to the killing range of cyanide gas:

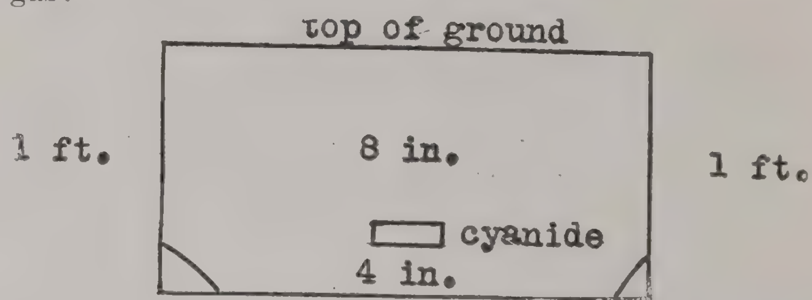


FIG. 76.—Diagram showing killing range of cyanide gas. (Original.)

Nine-tenths of the live worms were found in the corners. It will be noticed from the diagram that there is a considerable killing area below where the cyanide was actually placed.

As the season was growing late, these experiments were discontinued, and a trial in the field given. The soil picked for this was very light and sandy. Owing to the difficulty in packing, it was thought that this soil would furnish as severe a test as it would be possible to give. Through the work with the potato catch-crop it was learned that worms could be attracted considerable distance to bait, so split beans were

drilled into the ground with the two outer holes of a bean planter. This threw the rows 7½ feet apart. After leaving the bait in the ground for about two weeks in order to accumulate the worms in the rows of splits, an ordinary fertilizer drill was obtained and powdered cyanide thoroughly mixed with dry sand was drilled in on each side of the bean row and four inches away. In this experiment, covering exactly one acre, most of the cyanide was put in at the rate of one-tenth of one ounce of cyanide to each running foot, costing approximately $10.00 per acre. Two short strips were also put in, one at the rate of approximately $15.00 per acre and the other at the rate of approximately $5.00 per acre. Unfortunately, it was impossible to get the drill used into the ground more than 4 inches. The packing of the ground was done with a light hand roller tied behind the drill, and was far from satisfactory. Under the circumstances the results obtained were better than anticipated. The $5.00 strength gave a 35 per cent killing, the $10.00 a 50 per cent, and the $15.00 an 80 per cent. To obtain these percentages all of the worms found within one foot of the row on each side and to a depth of 8 inches were counted. It would be more desirable to leave the splits in the ground three or four weeks, not only to attract more worms into the rows, but also to allow the splits to rot or be devoured, as the cyanide fumes will not penetrate to worms inside the beans. After the worms get into the row there is little chance of their leaving, even though there is no food, as the natural tendency is to follow down the rows along the lines of least resistance. It is to be regretted that we were unable to give this method a more exhaustive test under more favorable conditions. With a drill capable of putting the cyanide down 8 inches and following with a crosskill and a heavy roller, excellent results could undoubtedly be obtained, using on sandy ground a $15.00 strength, on medium loamy ground a $10.00 strength, and on heavy adobe ground a $5.00 strength. Possibly these strengths could be lessened. It may also be possible to widen the distance between rows considerably as was done with the potato catch-crop. The rows of splits can also be examined ahead of the drill, and the ground treated only where there are worms. This method has the same disadvantage as the potato catch-crop, in that the worms may not be attracted to the bait in every case. Cyanide placed in the ground in a granulated condition gradually decomposes. This decomposition is practically complete within two weeks, so that beans can be planted with no ill effects.

Catch-crops.—To Mr. James Leonard of the Colonia district belongs the honor of being the first man in this section to use catch-crops with success. During the spring of 1914 the writer succeeded in interesting Mr. Leonard in trying to control the wireworms which were making very heavy yearly inroads on his bean crop. The previous year, 1913, the worms had been especially bad, practically cleaning up one 50-acre field and badly damaging others. At the writer's suggestion he decided to try out potatoes as a catch-crop. The first work done was quite crude, but as the experiment gave promise of success, better methods were worked out. The first work was done entirely by hand. The potatoes were cut up into pieces about one-half of an ounce to one ounce in weight; a wire with a white cloth attached to it was hooked through the potato to serve as a location mark, and the potato was then planted with a hoe or shovel. One acre was laid out in the field, and potatoes

were planted about seven feet apart each way. Upon picking them over a week later over 1,600 worms were taken out. In all, this acre was picked over five times during the season, and approximately 4,000 worms were taken out. The results of this first picking were so encouraging that it was decided to work on a large scale. Some preliminary work was done, planting rows 60 feet apart, then planting a row half way between after a few days to see if it caught worms, to determine the proper distance apart between the rows of potatoes. In this way the distance was narrowed down until no more worms were caught, and we had an approximate idea how far apart the rows should be. In the meantime a potato planter was rigged up by taking an old, two-hole bean planter and splitting the back of the feed pipes so as to allow the wires attached to the potatoes to slip through. Other labor saving improvements were made, such as using only straight wire that could be cut and handled much quicker and dipping the ends of the wires in whitewash to serve as indicators instead of tying on a cloth. About three weeks were spent in this preliminary work, and active work on a large scale was carried on some three weeks longer, or until planting time, about the 20th of May. In all, approximately 100 acres were worked over with potatoes planted two rows at a time 5 feet apart and about 6 to 10 feet apart in the row. A space of about 20 feet was left between the double rows. The potatoes were picked over every three or four days on an average. About 20 acres of the ground received five pickings, another 20 acres four pickings, still another 20 acres two pickings and about 40 acres three pickings. The total expense of the work amounted to a little less than $350.00, or an average of $3.50 per acre. In checking up the results it was possible to follow the work right straight through. The land picked over five times showed no worm damage at all. The land picked over four times showed a trace of worm damage, but was considered entirely satisfactory. The land picked over three times showed some worm damage, but on the whole was satisfactory. The land picked over two times showed the most worm damage and was not considered quite satisfactory. Some of the beans on land not worked over at all were severely damaged. On the whole the work done at Mr. Leonard's in 1914 was as good as could be asked for, but there was still some doubt as to whether the potato catch-crop would work as well in other places under different soil conditions. In a way these doubts were confirmed to some extent by the results obtained in 1915, but everything considered the potato catch-crop method proved quite satisfactory.

The first work done in 1915 in co-operation with Donlon Bros. was to determine the relative values of lima beans, beets, corn and potatoes as catch-crops. It was found that beets were not at all attractive to the worms. Very little preference was shown between lima beans, corn, scalded and raw potatoes. Raw potatoes were given the preference on account of being more suitable to use under field conditions. Another point brought out was the fact that the worms became more and more active as the ground warmed up. Potatoes were used continuously from the first of January until the beans were planted the latter part of May. While some worms were taken throughout this time, the conclusion reached was that it would not pay to start active trapping before the first of April in most cases.

In all about 360 acres of bean land were worked over with potatoes during the spring of 1915. This was divided as follows: James Leonard, 100 acres; Donlon Bros., 220 acres; Johnson Bros., 40 acres.

James Leonard found that land which had been worked over thoroughly the year before showed very few worms, and finally confined his experiments to one field which had not been gone over entirely the year before. The results were practically perfect stands of beans on all his holdings. The total cost for potato work done in 1915 was approximately $100.00.

Donlon Bros. went over about 220 acres with rows of location potatoes placed 150 feet apart. They then concentrated on the spots that showed the most worms. These spots (about 100 acres) were gone over with potatoes in rows 20 to 30 feet apart, dropping the potatoes 6 to 9 feet apart in each row. These potatoes were all put in with a single-hole planter of their own manufacture. Unfortunately, they only had time to make three pickings, which were not sufficient to get rid of the worms in some places where the infestations were extremely heavy. Several small spots were noted where the worms had been missed, apparently on account of having had the location rows too far apart. One 40-acre piece of sandy land was worked over with the location rows of potatoes without disclosing any worms, but the beans were very severely damaged after they had been up several weeks. In all, Donlon Bros. spent $220.23 in their potato work, divided as follows: cost of potatoes, $16.75; wiring and planting, $58.39; picking, $145.09.

Johnson Bros. worked over a 40-acre field with potatoes put 50 feet apart each way. In this way they were able to locate very definitely the area of infestation, amounting to about 15 acres. They then concentrated on this area, putting rows 15 feet apart and potatoes 6 feet apart in the row. They did all of their planting by hand and used little redwood stakes as location marks. When the potatoes were picked over, each man carried a little bag of potatoes and replaced any which were rotten or eaten by the worms. This ground proved to be very wormy. One piece of ground in the garden consisting of less than an acre showed a severe infestation. As high as 95 worms were taken from inside and around one piece of potato. Numbers running from 50 to 75 were not unusual. It is estimated that they took fully 25,000 worms out of this piece of ground in the six times it was picked over. Even then the work was not entirely satisfactory. In the main field it is estimated that they took out 100,000 worms in five pickings. The expenses of this work were as follows:

3 sacks of potatoes at $2.25	$6 75
Hired labor	21 00
Own labor	35 00
	$62 75

This makes an average cost of $4.20 per acre for the 15 acres directly concerned. The main field showed just one small infestation, less than 50 feet across. Otherwise they had nearly a perfect stand.

In this work in order to secure the best results it was found necessary to place the potatoes, each with at least one cut surface, well down into the moisture. It was also found that good sound, high grade potatoes were more economical than culls, for the reason that there was less loss

through decay, and the good potatoes were much more palatable to the worms. It also pays to pick over the ground immediately around the potato. Very often there will be more there than in the potato itself.

In order to secure definite cost data for all operations concerned, one acre was put in on the Donlon ranch in a badly infested field, and the exact cost of each operation noted. The picking was done partly by the writer and partly by Armenians. The rows were put in 15 feet apart and potatoes 6 feet apart in the row. It is thought that these figures will more than cover the average expense of treatment under average field conditions and with an average degree of infestation.

Cutting potatoes and affixing wires, 1 man $1\frac{1}{2}$ hours at 20 cents		$0 30
Planting (with a 1-hole planter), 2 men and team $\frac{3}{4}$ hour		50
Cost of potatoes (including replants), 12 lbs. at 2 cents		25
April 26, picking, 1 man 4 hours	1,038 worms	80
April 30, picking, 1 man $4\frac{1}{2}$ hours	1,556 worms	90
May 3, picking, 1 man $4\frac{1}{4}$ hours	788 worms	85
May 10, picking, 1 man $4\frac{1}{4}$ hours	877 worms	85
May 15, picking, 1 man 4 hours	1,072 worms	80
Total worms	5,331	Total cost $5 25

In checking over the results obtained on this one-acre plot, careful examination failed to show one single bean that had been injured by the worms.

After the beans were up and definite wireworm spots had been formed, the potato catch-crop was used in several instances in an effort to limit the size of the spot. The worms apparently will not leave the bean to feed on the potato; neither will they leave the potato to feed on the bean. By placing the potatoes around the outer edges of the spot and in the row with the beans, we were able to catch large numbers of worms, and we believe that we limited the size of these spots materially in this way. Efforts to catch the worms in the centers of these spots were not so successful, possibly because the worms had already relieved their hunger to a large extent from feeding on the beans.

It is impossible to set any definite figures on the amount saved through this potato work, owing to the fact that there was no possible way of establishing definite checks. The writer has ventured to insert the following table for consideration. These figures, while authentic, should not be misunderstood. Variations in the seasons and other factors enter in, but it is believed that a good substantial portion of the increase in yield shown was due to the control of the wireworms:

Name	Acreage	Acreage treated	Before treatment, 100-lb. sacks	After treatment, 100-lb. sacks	Cost of treatment	Difference, total, 100-lb. sacks	Difference per acre, 100-lb. sacks	Money value
Johnson Bros.	40	40	*540	†870	$62 75	330	8 25	$1,485 00
Donlon Bros.	580	220	*7,759	†8,358	220 23	599	1 03	2,695 50
James Leonard	250	*100	‡4,021	*6,199	*350 00	*2,175	*8 70	*9,787 50
James Leonard		†100		†6,639	†100 00	†2,615	†10 46	†11,767 50
					$732 98			

‡ 1913. * 1914. † 1915.

In both the potato and cyanide methods the two- and three-year-old worms are eliminated, as well as large numbers of one-year-old worms. Therefore, if work is done very thoroughly one year, it should not be necessary to treat the following year. In figuring out the benefits to be derived from wireworm control work this point should not be overlooked.

WORK AGAINST THE PUPAL STAGE.

Fall plowing has been advocated to some extent as a means of destroying the worm in the pupal stage, a time when it is very sensitive to disturbance of any kind. It is the writer's opinion that this has little value when applied to bean fields in this section, owing to the fact that it is usually about the first of November before the beans are off the ground and the land available for plowing. By this time a large majority of the pupæ have transformed into the beetle stage and would be influenced very little by plowing. If this plowing could be done earlier, it would undoubtedly be of considerable value.

WORK AGAINST THE ADULT.

When the wireworm beetles hatch from the pupæ during the early fall months, they usually lie in the old pupal cells in a dormant condition until the cold weather commences to dissipate in the spring. There is then a period of several weeks in which the beetles gradually emerge and seek any shelter available, such as weeds, old bean straw, old beets, or crevasses in the ground, where they stay for some time. This is termed the secondary hibernation period. There is always a percentage of these beetles which has been disturbed by plowing which goes into secondary hibernation, and this continues for a period of several weeks. Any warm sunshiny day thereafter the beetles may be seen walking around over the ground or in flight. If the weather turns cold, they all seek shelter and remain until the warm days return, and as the weather warms up the beetles increase their activities. The beetles are very strong fliers, some being noted to fly across a 200-acre field. Hundreds may be seen in the air at once at this time, and active mating begins soon after. The females commence laying eggs about the middle of April.

Last year when the beetles commenced to emerge from the ground in numbers, about the 5th of March, an attempt was made to collect them under small piles of bean straw. The writer obtained this idea from finding large numbers of beetles collected in bean straw used as a mulch around young lemon trees. These piles of straw were placed 150 feet apart in a field on the 8th of March. Examination on the 15th day of March of ten piles of straw selected at random in the field showed an average of 50 beetles to each pile. The least number of beetles collected under any pile was 23 and the most 80. As the beetles were becoming quite active, it was feared that they would emerge from these piles, so the piles were burned with the exception of one. These piles of straw burned up clean in every case, and not

a beetle was noted to escape. This pile remaining continued to collect beetles for ten days more, the record being as follows:

	Beetles collected.
March 15th	80
March 19th	15
March 26th	70
Total	165

Allowing three piles of straw to the acre and assuming that half of these beetles were females and each female lays an average of 100 eggs, and one-half of these eggs develop into worms, this would represent an infestation of approximately 12,375 worms to the acre, which is probably considerably more than the average infestation. By placing these piles of straw in the fields about the first of March and burning them at the proper time, these worms could all be eliminated at a cost of less than 25 cents per acre. It was interesting to note that the piles of straw which were wet and soggy did not harbor any beetles. This would necessitate the turning over of the straw piles in case of rain. These experiments were carried on in a field which had not been worked up after the rains. We would anticipate some decrease in effectiveness on land which had been worked up after the rains, as some of the beetles would undoubtedly take refuge among the clods. However, it is thought that this detraction would not seriously impair the success of the undertaking, provided the piles of straw are placed at the proper time. While it takes two and three years to realize any benefit whatever from this method, it strikes at the root of the worm trouble in the cheapest and most direct way possible. It is the writer's opinion that a district-wide campaign along the lines outlined above and continued each spring for a period of three years would show wonderful results in lessening the amount of worm damage.

CULTURAL METHODS OF USE.

Occasionally a farmer is met who believes he can control wireworms by some special cultural method, such as packing the ground with a crosskill, deep or shallow plowing, etc. Excepting fall plowing mentioned elsewhere, the writer does not believe these methods are of any practical value.

One field on the Donlon ranch which was badly infested with wireworms in 1914 was planted to barley in the fall, with the intention of turning it under as a cover crop in the spring of 1915. This barley was about 18 inches high when it was turned under in March, and the land was planted to beans in May. It was interesting to note that these beans suffered very little from wireworm attack, although it is believed that there were large numbers of worms in the ground. The supposition is that the worms had already satisfied their hunger to a large extent through feeding on the barley, or possibly they preferred the tender barley shoots to the beans. However, it would take observations extending over a series of years to properly determine the value of such methods.

Another common practice working along the same principle is to plant 100 pounds of seed instead of the customary 50 or 60 pounds.

in the hope that the worms will leave enough seed for a stand. This method certainly has some value, as the writer is willing to bear witness. He had two small plots of experimental beans planted at the rate of 40 pounds to the acre. These two experimental plots were very severely damaged, while the surrounding ground showed a fair stand of beans.

CONCLUSIONS.

Of the control methods mentioned above, it is the writer's opinion that the straw method of catching the beetles is the most promising from the standpoint of permanent success. In working against the worms, the potato catch-crop method is recommended in preference to the cyanide method because it is much cheaper and has also been more thoroughly worked out and tested on a much larger scale. A combination of the straw-trap method working against the beetles and the potato catch-crop method working against the worms should be especially effective.

While it is believed that these methods, if followed out in a thorough manner, are capable of solving the wireworm problem satisfactorily, it would be very desirable to have remedies which are not so complicated, especially against the worm stage. With this end in view, experimental work should be continued until the desired results have been obtained.

QUARANTINE DIVISION.

FINIS RATIONEM EXCUSAT.

Report for the Month of April, 1916.

By Frederick Maskew.

SAN FRANCISCO STATION.

Steamship and baggage inspection:

Ships inspected	76
Passengers arriving from fruit fly ports	3,920

Horticultural imports:

	Parcels
Passed as free from pests	144,793
Fumigated	1,575
Refused admittance	107
Contraband destroyed	27
Total parcels horticultural imports for the month	146,502

Pests Intercepted.

From China:

Larvæ of weevil in sweet potatoes.

From Florida:

Eudiagogus pulcher in celery.

From Hawaii:

Larvæ of weevil in seed pods.
Diaspis bromeliæ and *Pseudococcus bromeliæ* on pineapples.
Coccus longulus and *Aphis* sp. on betel leaves.
Howardia biclavis, *Lepidosaphes beckii* and *Pseudaonidia trilobitiformis* on hibiscus cuttings.
Larvæ of Trypetid in string beans, cucumbers and squash.

From Japan:

Phomopsis citri and Coccid on Japanese oranges
Larvæ of weevil in chestnuts.
Pseudaonidia duplex on camellias.
Egg cluster, *Porthetria dispar*, on wistaria.
Fungus on lemons.

From Missouri:

Coccus hesperidum, *Ceroplastes* sp., *Pseudococcus* sp., and *Pseudischnaspis bowreyi* on *Agave* sp.

From Tahiti:

Morganella maskelli and *Lepidosaphes beckii* on oranges.
Fungus on limes.
Larvæ of weevil in sweet potatoes.
Lepidopterous larvæ in seed.

LOS ANGELES STATION.

Steamship and baggage inspection:

Ships inspected	38

Horticultural imports:

	Parcels
Passed as free from pests	134,695½
Fumigated	39
Refused admittance	9½
Contraband destroyed	17
Total parcels horticultural imports for the month	134,761

Pests Intercepted.

From Arizona:

Lepidopterous larvæ and *Chloridea obsoleta* on tomatoes.

From Central America:

Aspidiotus cyanophylli and *Pseudococcus* sp. on bananas.

From Japan:

Diaporthe parasitica on chestnuts.

From Louisiana:

Lepidosaphes beckii and *Phomopsis citri* on grapefruit.

From Manila, P. I.:

Pseudococcus sp. and *Diaspis boisduvalii* on orchids.

From Mexico:

Chloridea obsoleta, larvæ and adults, on tomatoes.

From New Jersey:

Lepidosaphes ulmi on cottonwood cuttings.
Diaspis boisduvalii, Aspidiotus cyanophylli, Pulvinaria sp., *Coccus longulus* and *Chrysomphalus dictyospermi* on orchids.

From Pennsylvania:

Cerataphis lataniæ on *Cocos weddelliana.*
Coccus hesperidum on *Anthurium scherzerianum.*
Pseudococcus longispinus on Dracaena palm.
Unidentified Coccid on *Anthurium* sp.

SAN DIEGO STATION.

Steamship and baggage inspection:

Ships inspected	28
Fish boats inspected	22
Passengers arriving from fruit fly ports	218

Horticultural imports:

	Parcels
Passed as free from pests	5,208½
Fumigated	3
Refused admittance	5½
Contraband destroyed	2
Total parcels horticultural imports for the month	5,219

Pests Intercepted.

From Florida:

Phomopsis citri and *Lepidosaphes* sp. on grapefruit.

From Maryland:

Crown gall on berry plants.

From Mexico:

Fiorinia fioriniæ on cocoanuts.

From Nevada:

Crown gall on berry plants.

EUREKA STATION.

Steamship and baggage inspection:

Ships inspected	6

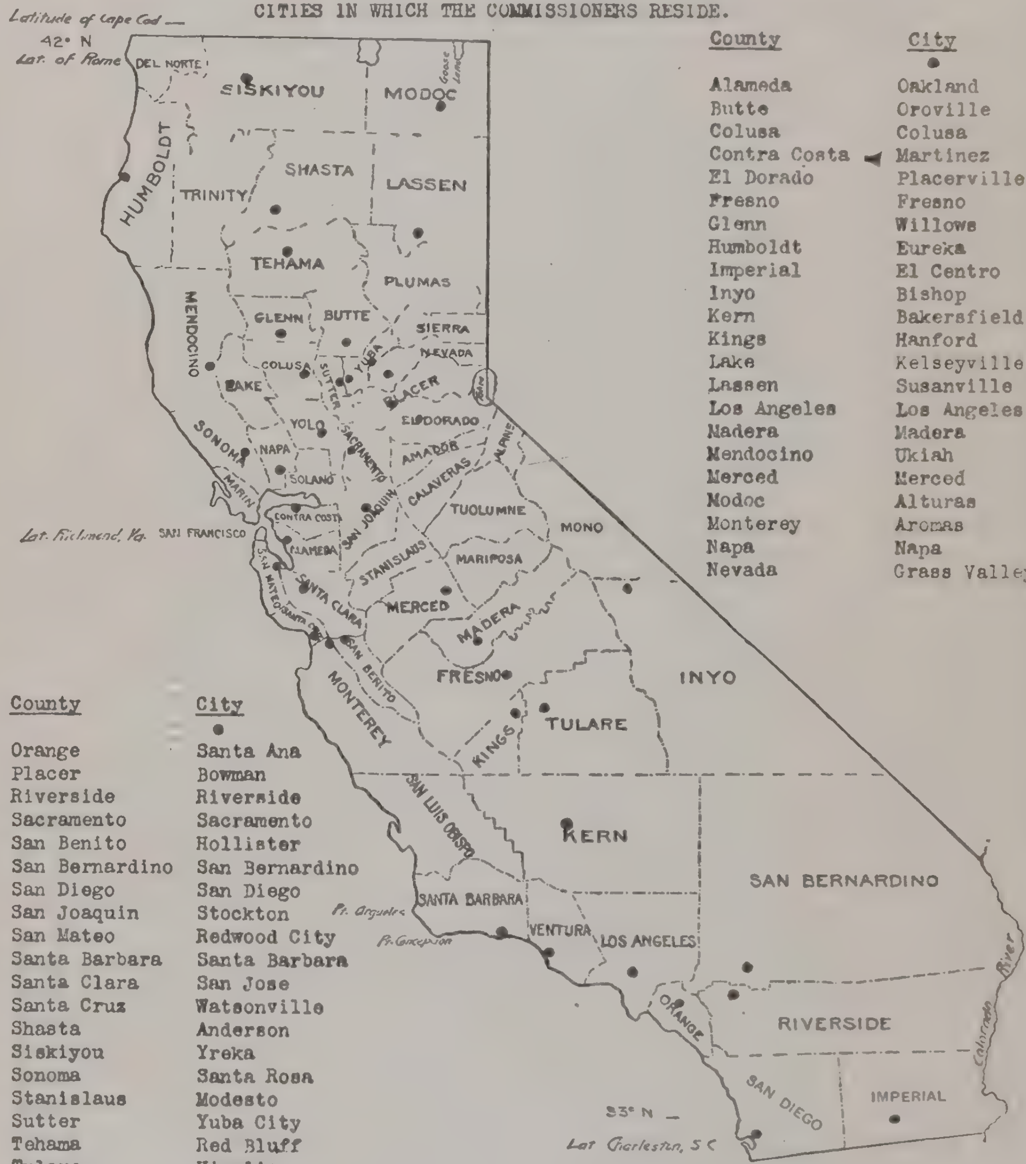
Horticultural imports:

	Parcels.
Passed as free from pests	23
Fumigated	-------
Contraband	
Total parcels horticultural imports for the month	23

SANTA BARBARA STATION.

(No report.)

COUNTIES HAVING HORTICULTURAL COMMISSIONERS, WITH THE RESPECTIVE CITIES IN WHICH THE COMMISSIONERS RESIDE.



County	City ●
Alameda	Oakland
Butte	Oroville
Colusa	Colusa
Contra Costa	Martinez
El Dorado	Placerville
Fresno	Fresno
Glenn	Willows
Humboldt	Eureka
Imperial	El Centro
Inyo	Bishop
Kern	Bakersfield
Kings	Hanford
Lake	Kelseyville
Lassen	Susanville
Los Angeles	Los Angeles
Madera	Madera
Mendocino	Ukiah
Merced	Merced
Modoc	Alturas
Monterey	Aromas
Napa	Napa
Nevada	Grass Valley

County	City ●
Orange	Santa Ana
Placer	Bowman
Riverside	Riverside
Sacramento	Sacramento
San Benito	Hollister
San Bernardino	San Bernardino
San Diego	San Diego
San Joaquin	Stockton
San Mateo	Redwood City
Santa Barbara	Santa Barbara
Santa Clara	San Jose
Santa Cruz	Watsonville
Shasta	Anderson
Siskiyou	Yreka
Sonoma	Santa Rosa
Stanislaus	Modesto
Sutter	Yuba City
Tehama	Red Bluff
Tulare	Visalia
Ventura	Ventura
Yolo	Woodland
Yuba	Marysville

THE MONTHLY BULLETIN.

CALIFORNIA STATE COMMISSION OF HORTICULTURE

Vol. V. July, 1916. No. 7

CALIFORNIA GRAPEFRUIT.*

By A. D. SHAMEL, Physiologist, U. S. Department of Agriculture, Riverside, Cal.

The poor reputation of California grapefruit as a whole, particularly in many eastern markets, has led many people to doubt the advisability of any attempt to grow, or, at any rate, extend the culture of this crop commercially in California. Amongst the causes for this condition, three of special importance may be mentioned: first, the planting of inferior varieties or those not suitable for California conditions; second, the planting of graptfruit trees on soils and under other conditions not adapted to the production of the best quality of fruit; and, third, the attempt to market the fruit before it is ripe.

The early plantings of grapefruit in California, were of Florida varieties which were selected without much knowledge of their adaptability to California conditions. It is only in recent years that any real knowledge has been developed of the comparative value of several varieties for this state. Of the varieties fruited so far, one, the Marsh Seedless, stands out clearly as particularly adapted for California conditions and is of genuine commercial value.

It is becoming more and more evident that the grapefruit trees planted on rather light, porous and sandy soils produce fruit of superior

FIG. 76.—Blossom end and side view of standard type of Marsh Seedless grapefruit. Reduced. (Original.)

commercial quality, color, and texture of rind to those planted on the heavier clay soils. That there is a relation between the character of soil and the commercial quality of the fruit can hardly be doubted.

*Address before the Special Citrus Convention, San Bernardino, Cal., February, 1916.

24526

Many of the older grapefruit orchards were planted on the lower valley and heavier soils, while most of the more recent plantings have been made either on higher lands having lighter soils or on soils possessing the desirable characters of texture and other conditions found by experience to be best for the production of this fruit.

A part of the California grapefruit crop is usually picked green or before it has fully ripened, and, as a result, its quality and flavor are frequently poor. An early variety is needed, producing fruit which will ripen from October until February for California markets, and this is one of the achievements worthy of the serious attention of citrus breeders and propagators. As a rule, the California grapefruit crop of the established valuable variety ripens from May until July, and some of the fruit can usually be held on the trees until September. Under proper conditions, this late fruit can usually be held in storage safely until about the last of November with constantly improving flavor and little loss of weight from shrinkage. These conditions are: first, a uniform, cool temperature; and, second, a uniform condition of humidity of about 90 per cent. The uniformity of humidity can be secured by ventilation and the use of proper humidifiers. The condition of humidity in the storage rooms should be carefully determined by means of the sling psychrometer two or three times each day. Naturally, the fruit for storage must be picked with the best of care in order to eliminate so far as possible all mechanical injuries which are likely to result in decay, the development of which is particularly favored by the high humidity necessary for successful storage conditions.

NAME.

A few years ago, about the time when grapefruit became recognized as a valuable citrus fruit, an extended discussion of the proper name for this fruit was carried on by several horticultural associations. The American Pomological Society, various state horticultural associations, and other similar organizations, agreed upon and adopted the name pomelo. Considerable confusion has existed as to the proper scientific name of the grapefruit. Hume[1] gives both the pomelo and the shaddock under *Citrus decumana* L. More recently Swingle places them in another species, *Citrus grandis*.

The name pomelo has never been accepted by the fruit trade or public generally. It does not seem likely that it will ever come into common use. For this reason, when the writer began six years ago some systematic studies of one variety commercially important in southern California, the name grapefruit instead of pomelo was adopted for performance record and other investigations. Later, such authorities as Webber and others have agreed upon the desirability of using the name grapefruit for all purposes, so that it has seemed wise in this paper and in our work as a whole to accept this commercial and almost universally used name. Hume[2] quotes Risso and Porteau in their "History and Culture of Oranges," published in 1872, as follows:

> "The author of the Flora of the Antilles has equally observed the pomelo cultivated in Jamaica, where the inhabitants call it grapefruit. * * * The fruits are gathered in clusters of from 15 to 18 on the branch, each of the size of the fist, spherical, firm, with a slightly rough skin of sulphurish yellow."

[1]Citrus Fruits and Their Culture, p. 17.
[2]Florida Experiment Station. Bulletin No. 58, p. 387.

The name grapefruit, therefore, it would seem from this account, has been used for many years. The writer can see no real objection to its use. It seems a matter of relatively little importance as to which name is used, except that a uniform one is preferable in order to avoid misunderstanding. Grapefruit, being more commonly used than pomelo and better established in the public mind, is now, in the opinion of the writer, a more logical one than pomelo.

VARIETIES.

Of the Florida varieties of grapefruit planted in California, the ones most frequently tried have been the Triumph, Duncan and Marsh Seedless. The writer has been shown individual trees of other varieties in several southern California orchards, but knows of no commercial plantings in bearing of other varieties than those named above. Trees of so-called seedling origin or of uncommon and probably comparatively recent introductions have also been found in fruit in a few places. As a matter of fact, the writer knows of no careful and adequate comparative trial of grapefruit varieties in California. The extensive propagation and planting of a carefully selected and extensive collection of types and varieties undertaken by the Citrus Experiment Station, at Riverside, will undoubtedly give us much needed and reliable information as to the comparative merit of the established varieties from Florida and other grapefruit districts in this country and abroad for California conditions.

The Triumph grapefruit trees in southern California observed by the writer produce large yields of rather small fruit, containing many seeds, usually from 25 to 50 in each fruit. This character bars this variety from serious consideration for commercial planting in California.

The Duncan grapefruit trees observed in southern California tend to produce rather large, round fruit, usually containing more than the number of seeds desired for market purposes. The fruit observed has had a thick rind as a rule, the quality of the juice was somewhat inferior, and the rag was coarse in texture and very bitter. The last characteristic may have been due to local conditions, as no comparison was made with other varieties of grapefruit grown under the same conditions.

The Imperial, Colton Terrace Seedling, Aurantium, Commercial and Blood varieties and types of grapefruit and the Sampson tangelo have also been propagated and planted to some extent in California. The results of these plantings have not as yet demonstrated them to be a commercial success in California. Similar isolated plantings of related and other varieties of grapefruit are still in the experimental stage so far as California is concerned, and need not be considered further in this discussion.

The Marsh Seedless, or Marsh, variety of grapefruit has been found to be the best of all the varieties grown in California and in districts having similar conditions. If all of the plantings in California of varieties other than Marsh Seedless from which fruit is marketed were replaced by Marsh Seedless, either by replanting or rebuilding the established trees, the writer is strongly of the opinion that the result would be very beneficial to the industry as a whole.

According to Hume,[3] the Marsh Seedless variety was introduced in Florida by C. M. Marsh, of Lakeland, Florida. The original tree was

[3]Citrus Fruits and Their Culture, p. 120.

said to be a seedling, but the writer wishes to point out the fact that nearly every fruit grower upon finding an unusual tree in his orchard has called it a seedling. This universal custom is responsible for much misinformation concerning the origin of fruit varieties. The writer would like to suggest to citrus fruit growers and others that unless it is definitely known whether or not a tree originated from a seed or a bud, the origin of the tree be left in doubt and a simple statement of the facts concerning the finding of the tree be made and recorded. There is no longer any reason or excuse for any one's jumping to the conclusion that an odd or unusual tree must of necessity be of seedling origin.

In connection with the history of the origin of this variety, the further statement is made that "this pomelo has not the distinct, pronounced flavor of the typical fruit, but the quality is good, and the fact that it is so nearly seedless is a very desirable feature." This statement concerns Florida-grown grapefruit and is a comparison of the Marsh Seedless with other Florida-grown varieties. It is an illustration of the fact that the behavior of a variety in one section of the country is not a reliable criterion of its behavior in other districts having different climatic, soil, and cultural conditions.

DISTRIBUTION OF PLANTINGS.

According to Vaile,[4] in his discussion of the "Outlook for the Pomelo," 600 acres of grapefruit trees are in bearing in California (1915), from which 250 carloads of fruit will be shipped and marketed this

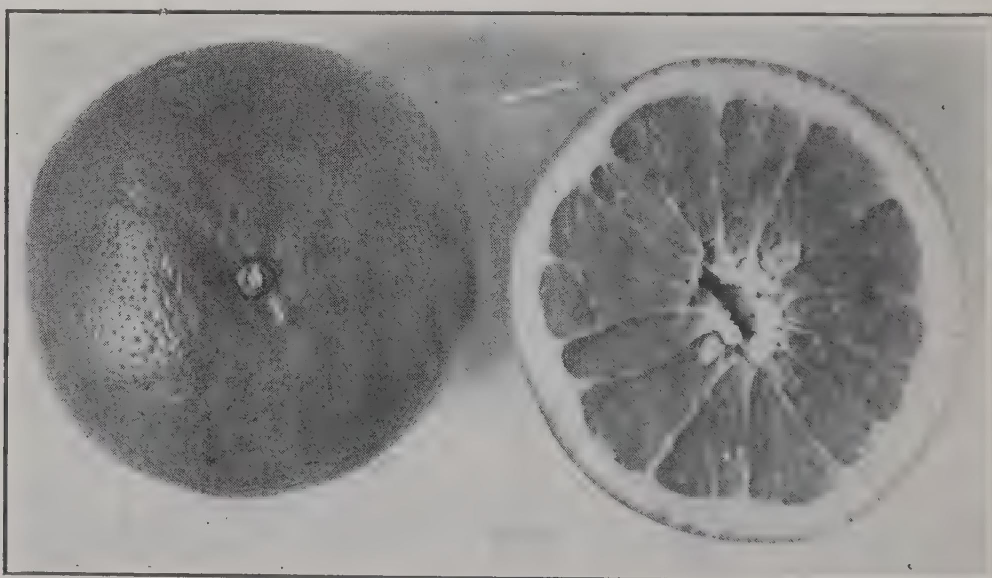


FIG. 77.—Cross section and stem end views of standard type Marsh Seedless grapefruit. Reduced. (Original.)

season. One thousand one hundred additional acres of trees are under five years of age, from which it is estimated the California output will be more than doubled in the coming five years.

Further, Vaile states in this report that Florida has some 16,000 acres of full-bearing grapefruit trees, from which this season about 8,000 carloads of fruit will be shipped. In addition to this large planting,

[4]Monthly Bulletin, California Commission of Horticulture, for November, 1915, p. 509.

Florida has about 45,000 acres of grapefruit trees between the ages of one and five years, which in the next five years should produce a crop of about 35,000 carloads.

Porto Rico,[5] in 1913, exported to the United States 216,216 boxes of grapefruit, or about 500 carloads, estimating 400 boxes to the car. Cuba, in 1912, exported to the United States the equivalent of about 250 carloads of grapefruit. In both Cuba and Porto Rico there are reported to be large new plantings of grapefruit trees, so that the export of this fruit to the United States and elsewhere is likely to increase greatly over the past records. A comparatively small but rapidly increasing export of grapefruit to the United States from Jamaica and some other foreign grapefruit growing sections is evident from the observations and figures available for study.

Vaile[6] offers the following comment on the grapefruit situation in California in consideration of the conditions in other grapefruit districts which compete with the California product:

> "* * * The grapefruit situation in California is on a reasonable and sound basis at present. It may be expected that the industry will be as profitable as any for a period of years. * * * We would strongly suggest that future plantings be very conservative. We hesitate to recognize the wisdom of seeking new acres adapted to this crop, and we sincerely deplore the commercial boosting of large tracts of new lands for grapefruit culture."

At least two facts must be remembered in considering this discussion, first, that Florida or foreign grapefruit is no longer admitted into California on account of the danger of the introduction of insect pests and fungous diseases through this means. No doubt other western states where grapefruit is being grown will sooner or later adopt similar protective measures, so that the population of these states and their eastern or other visitors will have to be supplied with home-grown grapefruit; second, the period of ripening of California Marsh Seedless grapefruit is during the summer months when no other known district has a ripe crop available to supply the great eastern markets. For these and other reasons California has an opportunity to develop a strong grapefruit industry, in the opinion of the writer, provided only the best possible grade of grapefruit is produced and the fruit is allowed to ripen before picking. The green, bitter, and strongly acid fruit often found on the market under present conditions offers a strong argument for the establishment of a standard of ripeness for grapefruit by the growers, as has been done for the orange. For their self-protection growers should look into this matter carefully from an unprejudiced point of view and squarely face the consequences to the future of the industry of a continuation of the present unfortunate and uncontrolled system of marketing California grapefruit.

RELATION OF COMPOSITION AND OTHER CHARACTERISTICS TO QUALITY.

The Bureau of Chemistry of the United States Department of Agriculture, through the laboratory of by products, located in Los Angeles, has been making some chemical studies of the composition of grapefruit

[5] Wallschlaeger, Bulletin No. 11, Citrus Protective League of California, p. 51.

[6] Monthly Bulletin No. 11, California Commission of Horticulture, November, 1915, p. 510.

for the purpose of establishing more definite and intelligent knowledge to be used in the consideration of the comparative degrees of ripeness of this fruit and the time of picking. The results of these experiments to date are of vital interest and importance to grapefruit growers from the standpoint of an intelligent consideration of the problem of marketing this crop and the establishment of a good reputation for it. The success of the California grapefruit industry, in the opinion of the writer, will largely depend upon an unprejudiced study by the growers of the condition of ripeness, the value of grapefruit when picked at different times during the season, and the adoption of intelligent and fair standards of maturity and ripeness for marketing.

In this connection the following analysis, furnished by Mr. E. M. Chace in charge of the Citrus By-products Laboratory, Bureau of Chemistry, Los Angeles, California, of California grapefruit, made during December, 1915, and of Florida grapefruit, made in November and December, 1912, are of special interest.

Analysis of Florida and California Grapefruit.

(Analyses of California fruit made during December, 1915, and of the Florida fruit in November and December, 1912.)

Description	Date analyzed	Total solids	Total sugar	Acid	Acid solids, ratio
California No. 1	Dec. 22	10.30	6.25	2.07	5.0
California No. 2	Dec. 20	10.10	5.90	2.22	4.5
California No. 3	Dec. 21	11.18	7.20	2.04	5.5
California No. 4	Dec. 21	12.41	7.80	2.42	5.1
California No. 5	Dec. 16	12.03	7.01	2.63	4.6
California No. 6	Dec. 16	9.37	5.39	2.09	4.5
California No. 7	Dec. 18	11.22	6.87	2.31	4.9
California No. 8	Dec. 13	10.73	6.57	2.24	4.8
California No. 9	Dec. 20	10.42	6.33	2.09	4.8
Florida No. 1	Dec. 20	----------	6.30	1.26	8.0
Florida No. 2	Dec. 17	----------	7.14	1.48	7.0
Florida No. 3	Dec. 3	----------	7.88	.90	12.5
Florida No. 4	Dec. 24	----------	6.29	1.34	6.8
Florida No. 5	Dec. 29	----------	8.41	1.58	7.6
Florida No. 6	Dec. 27	----------	8.29	1.53	7.7
Florida No. 7	Dec. 30	----------	7.07	1.16	8.7

NOTE.—Acid solids ratios on Florida grapefruit are estimated, as no soluble solids were determined. The acid sugar ratio is considered as 70% of the acid solid ratio.

While these analyses are not meant to be comparative, they do bring out some facts worthy of our most careful consideration from the standpoint of the best interests of the California industry. A careful study of this table will make it self-explanatory, so that no further comment at this time is necessary.

The composition and acid solids ratios of samples of standard, rough, seeded and smooth types of Marsh Seedless grapefruit from one of the best groves in southern California are shown in the following table, prepared by Mr. E. M. Chace. The samples were picked at the beginning of the ripe period. It is to be hoped that during this coming season samples picked at regular intervals throughout the entire picking period will be analyzed for the benefit of the growers of grapefruit. Further studies along this line are necessary in order to secure necessary reliable information for consideration in solving satisfactorily the marketing problem for grapefruit.

Analysis of Representative Types of California-Grown Marsh Seedless Grapefruit During Ripe Period.

Grapefruit, description	Date picked	Average weight per fruit	Rind, per cent	Pulp, per cent	Juice, per cent	Number seeds, per fruit	Total solids in pulp, per cent	Soluble solids in juice, per cent	Total sugar in juice, per cent	Acid in juice, per cent	Solids, acid ratio
Standard type	June 11, 1915	574.0	28.72	71.03	69.63	10.0	12.92	11.52	7.50	1.28	9.0
Rough type	June 11, 1915	618.3	39.84	57.96	56.01	57.0	14.01	12.06	7.27	1.55	7.8
Seeded type	June 11, 1915	589.5	39.16	58.58	56.97	59.8	13.82	12.21	7.60	1.59	7.7
Rough seeded type	June 12, 1915	580.5	35.64	62.00	60.43	60.0	13.49	11.92	7.65	1.45	8.2
Smooth seeded type	June 12, 1915	583.0	31.76	65.90	64.15	58.7	12.46	10.71	6.80	1.35	8.0
Seeded type	June 16, 1915	560.8	34.95	62.47	63.04	59.0	13.38	11.65	7.40	1.51	7.8
Seeded type	June 16, 1915	529.3	36.45	61.06	59.38	61.0	13.86	13.18	7.77	1.61	7.6
Seeded type	June 16, 1915	617.5	33.57	64.03	62.30	56.0	13.85	12.12	7.47	1.39	8.7
Smooth type	June 15, 1915	584.7	31.47	68.38	66.99	.9	13.50	12.11	7.35	1.33	9.1
Smooth seeded type	June 16, 1915	614.2	31.12	66.81	65.44	50.5	11.66	10.29	6.51	1.25	8.3
Rough type	June 16, 1915	523.0	39.95	57.58	55.62	57.1	13.85	11.89	7.40	1.50	7.7
Standard type, unpruned	July 12, 1915	441.9	27.57	72.13	70.69	5.5	12.79	11.35	7.49	1.40	8.2
Standard type, pruned	July 12, 1915	467.8	28.07	71.73	70.49	4.0	12.09	10.85	7.25	1.29	8.4

VARIABILITY OF MARSH SEEDLESS VARIETY.

In one of the first groves of Marsh Seedless grapefruit observed by the writer in southern California it was found that out of a total of 500 trees, 123 habitually produced fruit containing from 50 to 100 seeds each. In some cases this heavily seeded characteristic was found to be correlated with a rough, thick rind and an undesirable shape of fruit. This type has since been proven to have originated from bud mutations. It has been unintentionally propagated through the absence of any careful system of bud selection based on individual tree performance

FIG. 78.—Side view of coarse, thick-skinned type of Marsh Seedless grapefruit. Reduced. (Original.)

records. To illustrate the importance of this condition, it can be said that the owner of the grove referred to above has lost thousands of dollars in the past through the unwelcome presence of this poor type of trees. Fortunately, the trees belonging to this poor type are light bearers of fruit, as a rule, so that the loss resulting from the mixture of an inferior type of fruit has been less than otherwise would have been the case.

The important types of Marsh Seedless trees and fruit found so far in our performance record work are as follows:

1. *Standard.* The trees of this type produce a large and regular crop. The fruit has characteristically a slightly flattened shape. The ripe fruit representative samples of which are shown in Figs. 76 and 77 has a very smooth, satin-like skin of ivory white color, thin rind and from none to ten seeds each, being commercially seedless. The rag is

tender, having a slightly bitter taste which is pleasant and agreeable. The fruit has an abundance of juice that spurts when the fruit is cut. The juice possesses the desired and typical grapefruit quality, a highly developed pleasing flavor that is only equalled among California citrus fruits, in the opinion of the writer, by the fine flavor of the Washington Navel orange. This type is worthy of a separate varietal name in that it has been successfully isolated in California by bud selection and is being extensively propagated by California citrus growers.

2. *Seeded.* The trees of this type differ but little in appearance or fruiting behavior from those of the standard type. The fruit is very similar in appearance to the standard type fruit and can hardly be sorted out from that of the standard type by even the most experienced workers. The fruit is usually heavily seeded, averaging about 75 seeds each. Otherwise the characteristic quality of the fruit is as satisfactory as that of the standard type.

3. *Flattened and wrinkled.* The trees of this type usually have a more upright habit of growth than that of standard type trees. The fruit has but few seeds, but frequently is lacking in juice, which is likely to lack flavor, and is comparatively poor quality. The rag is usually rather coarse and bitter. The wrinkled appearance around the stem of the fruit detracts from its attractiveness for commercial purposes. This type is distinctly inferior to the standard type. It occasionally occurs as limb sports in standard trees, in which case it can be eliminated by pruning.

4. *Corrugated.* The trees of this type are similar in appearance to those of the standard type. The fruit is usually globular in shape. The rind is ribbed, so as to give a ridged or corrugated appearance to the fruit and is usually thick. The color of the rind is likely to be yellowish green and it never assumes the highly desired clean ivory-white appearance. The rag is tough and very bitter, and the juice is of inferior quality. This type also appears as limb sports in standard type trees, in which case it can be removed by pruning.

5. *Bell-shaped.* The bell-shaped type trees are usually dwarfed in appearance and have a drooping habit of growth. The fruit has a characteristic bell, or pear-like, shape, resembling somewhat the shape of typical shaddocks. The rind is usually very thick and the skin possesses a yellowish cast. The rag is usually coarse and tough and the juice of poor quality. The trees of this type are usually light bearers as compared with trees of the standard type.

6. *Rough.* The trees of this type are likely to have a dwarfed appearance and produce but a light crop except at infrequent intervals. The fruit, a representative sample of which is shown in Plates 3 and 4, is usually globular in shape, unattractive in appearance, has a thick rind, tough rag, an inferior quality of juice and many seeds.

SPORTS.

Aside from the types listed above we have occasionally found navel grapefruit sports, fruit having raised or lowered sections, some resembling closely in size, shape, appearance and somewhat in flavor typical Valencia or other oranges, and many minor variations of little importance from a commercial standpoint. From the breeding viewpoint these variations, or fluctuations from the standard and other types, are of interest and possible importance.

In this connection we can not help but mention the peculiar so-called off-bloom fruit occurring more or less on trees of all grapefruit types. This fruit is frequently misshapen, having a thick rind, and is as a whole of inferior quality, even when ripe. The writer has no suggestion at present to offer as to the causes for this condition or a remedy for it. The number of these offbloom fruits seems to vary with seasonal conditions.

ISOLATION OF THE STANDARD TYPE.

Enough work has been done to prove that the standard and valuable type of the Marsh Seedless variety can be isolated in propagation by bud selection based on individual tree performance records. A method for securing and using these records was presented at the meeting of the

FIG. 79.—Cross section of coarse, thick-skinned type of Marsh Seedless grapefruit. Reduced. (Original.)

California Fruit Growers' Convention at Visalia in November, and need not be repeated here. There is no doubt in the writer's mind but that the standard type can be further improved by intelligent bud selection, both as regards the quantity and quality of production.

ELIMINATION OF POOR TREES IN ESTABLISHED ORCHARDS.

Performance records of individual bearing trees will locate those of inferior type in the established orchards. These trees can be topworked successfully, using for this purpose select fruit-bearing budwood from the best trees of the standard type.

PRUNING.

The principle of pruning grapefruit trees is not fully settled. So far as the writer's observations have gone, the best method of pruning for young trees is to lay the foundation for strong tops by careful heading, not allowing all of the main branches to arise at one point, and by some careful thinning of the new growth from time to time. It is probably a good plan to cut out most of the distinctly marked sucker growth and when necessary to remove the dead branches. When the period of maximum production begins to wane, it now seems probable that it may be best to cut off the old tops and grow new ones; in other words, renew the trees. If the type of tree and fruit are not exactly desirable, the time of tree renewal is the proper period for topworking by rebudding, so that the new tops will be produced from buds instead of from sprouts.

OUTLOOK.

As a whole it appears to the writer that there is established a good foundation for the development of an important California grapefruit industry. If the crop as a whole can be brought to a uniform standard of ripeness and quality before marketing, it is probable that a superior reputation for quality can be established for this fruit in many markets. The writer believes that the best type of California Marsh Seedless grapefruit, grown on suitable soil and under proper climatic and cultural conditions, is of the highest quality and value. Without exception so far, all visitors from many parts of the world who have tested the fully ripened fruit in our performance record plots from the standard type Marsh Seedless trees, have expressed their opinion that no better grapefruit is grown or has been tried in their experience.

In Vergil's[7] time citrus fruits were called citrons. The curative powers of these fruits for asthma and poisons were celebrated by him two thousand years ago as follows:

"The Median fields rich citron fruits produce,
Tho' harsh the taste, and clammy be the juice;
Blest antidote! which when in evil hour,
The step-dame mixes herbs of pois'nous power,
And crowns the bowl with many a mutter'd spell,
Will from the veins the direful draught expel.
Large is the trunk, and laurel-like its frame,
And 'twere a laurel, were its scent the same:
Its lasting leaf each roaring blast defies,
Tenacious of the stem its flow'rets rise;
Hence a more wholesome breath the Medes receive,
And of their sires the lab'ring lungs relieve."

[7]Vergil, Georgic, lb. ii-v. 126-135.

PRUNING AND TRAINING A YOUNG LEMON ORCHARD.

By W. H. FLEET, Sespe, California.

It is not my intention in presenting this subject, "Pruning and Training a Young Lemon Orchard," to ridicule or to condemn other methods, but rather to give you some of the results of my long experience in growing lemon trees, and to tell you of a method of pruning which the Rancho Sespe has followed for six years, and up to the present time has found no reason for changing. I do not know of anything that concerns the lemon grower more today than the pruning and training of his lemon trees.

FIG. 80.—Young lemon tree ready for the first pruning. (Original.)

Almost twenty-eight years ago when I began my citrus experience in the east end of Ventura County, I soon realized there was no uniform method of pruning or training young lemon trees. Men were going through the country calling themselves expert pruners. They did not own an orchard and had never paid much attention to the fruiting qualifications of the tree, as they never pruned an orchard more than once a year. These men were employed to do the general spring prun-

*Address before the Special Citrus Convention, San Bernardino, Cal., February, 1916.

ing, and as a general rule the owner of the orchard did not realize that it was necessary to follow up this one pruning with a thinning out and adjusting of limbs in the tree which had been started by the first vigorous pruning, cutting back those limbs which had grown in proper places to add to the framework of the tree, of which I will speak later. These expert pruners seemed to have but one idea, and that was to prune for shape, cutting off lower limbs so as to enable one to cultivate under the tree. Some of them held that their method of pruning would make the tree bear its fruit inside, which would have been the case, if the cuts had been made right and the growth properly adjusted in the

FIG. 81.—Young lemon tree cut back to 32 inches, ready for crowning. (Original.)

tree. They also advised cutting the side limbs to keep the teams from rubbing against and breaking the tree. Shape seemed to be the predominating idea, vase shape, goblet shape—a shape with hollowed center, called the Borneo system. I would rather take a bright intelligent young man who could not tell a lemon tree from an orange tree and teach him to prune than to employ any of these so called experts.

After more than twenty-seven years' experience with the lemon tree I have observed this: that it is a case of building. The lemon tree has to be watched closely and built up, year by year, and deck by deck. It is almost impossible to tell any one how to prune unless there is some

way to demonstrate just how the pruning should be done. If I had this audience up on the Rancho Sespe where there are lemon trees from nine months to seven years old, I could speak more intelligently on my subject. I would begin with a tree just planted and show the method of pruning which has been practiced on this ranch. As it is out of the question to take you to the grove, I have brought a part of the grove with me and some pictures showing the method.

FIG. 82.—Lemon tree one year from bud, ready to be cut back at proper points to be planted in the orchard. (Original.)

This system can be followed up to the age of five or six years with the Lisbon lemon, with the exception of a little more thinning; that is, the Lisbon tree is more inclined to grow thicker than the Eureka.

The first and most important thing to consider is the building of the framework of the tree which must carry a heavy load of fruit and which should be strong enough at bearing age to support this weight without breaking. When preparing to build one naturally considers first the materials to be used. Therefore, I want to consider the material necessary in the construction of a lemon tree, of which three kinds are needed: building wood to construct the frame, fruit limbs and spurs to bear fruit. How may these different kinds of growth, or material, be distinguished? Building wood is that part of the growth that is

inclined to grow straight up, or vertical, and when a tree is young, sometimes outward at an angle. Fruit limbs grow from one foot to 2½ feet long and are distinguished by their position on the frame of the tree and by the end of the limb, which shows matured leaves and indications of buds forming at the tip. Sometimes a blossom occurs and often a little cluster of lemons. Fruit spurs are the growths that come on these fruit limbs, as also on the framework of the tree, if the tree is of a fruiting nature.

FIG. 83.—Showing lemon tree one year in the nursery, cut back ready to plant in orchard form. (Original.)

There is another growth of the lemon tree about which there is a good deal of discussion, *suckers* or sucker wood. A growth, or sprout, is only a sucker when it grows on that part of a tree already developed where it can not be used. The question has been raised, When is a sucker not a sucker? I would answer it this way: when something unexpectedly happens to some part of the tree so that the sucker can be used, not for a fruit limb, but as a part of the tree. Several times I have had this experience. A large limb has split off one side of a tree, just above it being a sucker from one foot to sixteen inches long. The split limb was taken off entirely and the abrasion smoothed off and painted. The sucker was tied to the main part of the tree to prevent its breaking off

until it was large enough to cut back at a proper point to make it branch and spread to fill in that part of the tree where the broken limb was taken out. In this case this sprout was a sucker when it could not be used, but when circumstances permitted its use it was no longer a sucker.

This building of a lemon tree is accomplished by a systematic cutting out and back. This does not necessarily mean that the tree should not be expected or allowed to bear fruit during the building of the frame. More and better fruit will be produced at an earlier date than if the

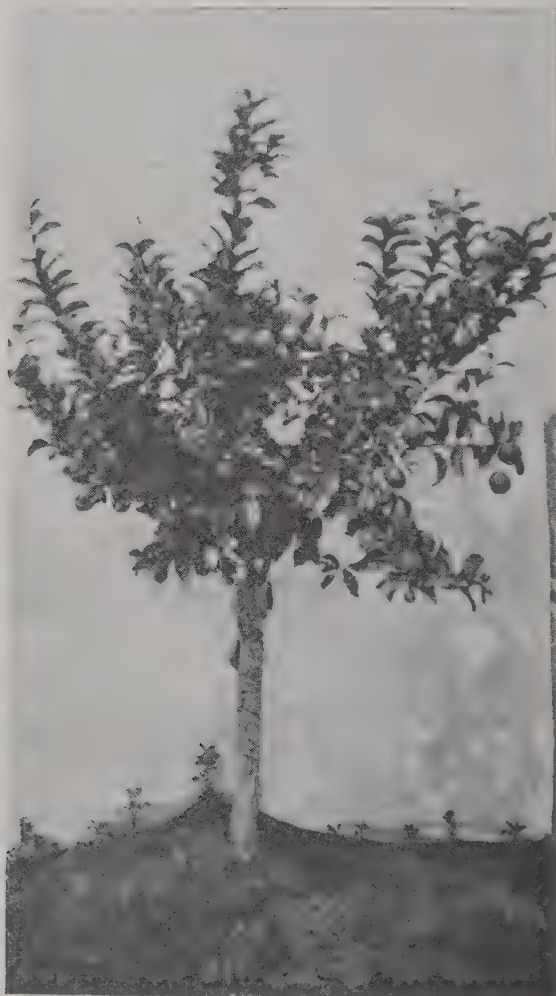


FIG. 84.—Showing appearance of a two-year-old lemon tree before pruning in the spring. (Original.)

tree had been allowed to follow its natural propensities, as the fruit limbs and fruit spurs will develop each year in the part of the frame which has been built the year or years previous. It must be remembered while building the framework of the tree that fruit limbs and fruit spurs are being developed also, and care must be exercised during the building process not to trim out these fruit limbs or fruit spurs except where they are too thick. Never crop off the ends of the fruit limbs or fruit spurs.

The question when to begin to build or train a lemon tree is an important one. Just as soon as the bud grown from the seedling stock

has reached a height in the nursery so that it may be cut off at a point where there is matured wood, 32 to 34 inches from the ground, this is the time when the beginning of the training and developing of the tree should be considered.

Figure 80 shows a baby tree ready to be cut back and enter its childhood. I call it a "baby tree" because it has been up to this date nursed, held up by stakes, and given every care, not having been trusted one minute to its own propensities. Now, it is to be cut back, and on

FIG. 85. Same tree as shown in Fig. 84 pruned ready to begin its spring growth. (Original.)

the little stick or stem will be built a crown as a foundation of the tree that hereafter must carry hundreds or even thousands of pounds of weight.

Figure 81 shows the baby tree cut back to 32 inches, ready for crowning, as I have mentioned before. Of course, the height of cutting back to begin the crown or framework is a matter of choice with the nurseryman or orchardist for whom the nurseryman is growing the trees. I prefer a crown started within 32 to 34 inches of the top of the ground.

Figure 82 shows the tree one year from bud, ready to be cut back at proper points to be planted in the orchard. I want to call your attention to one important thing which I have tried to show in this picture,

the spacing of the crown limbs. You will notice that there are four branches or crown limbs that have been allowed to grow out from the stem referred to in Figure 81. These crown limbs have grown out at different points on this stem, no one being opposite another. It is not always possible to carry out this particular plan in the crowning of the tree, but in most cases the limbs can be spaced so as not to allow one to come exactly opposite another, this to avoid too much strain at that point which may result in the limbs splitting off. I would prefer to

Fig. 86.—Tree same age as that shown in Fig. 85, pruned but larger. (Original.)

have only two limbs with the center stem. if it were not possible to grow four without having one opposite another. Three crown limbs are enough and four are plenty. The tree in Figure 82 is fairly well spaced, but if the crown limbs were a little farther apart, it would be better.

Figure 83 shows the same tree one year in the nursery cut back ready to plant in orchard form. You will notice that it has been cut back short. It is dangerous to make the cuts too long the first two or three years, as long cuts mean small limbs and weak frames. If this tree is planted early and makes a good growth, the first pruning may be necessary in August or September. This will be the thinning out of the top

branches and cutting back rather short those limbs which are needed to make part of the framework. By first pruning I am not alluding to suckering or rubbing off the water sprouts, etc. It is very important to keep the tree free from suckers, especially the trunk. A young tree should be watched very closely the first two or three years. If it forms the habit of suckering, especially on its trunk, there will be trouble in starting the sap in full flow through the limbs and foliage of the tree. Also allowing the suckers to grow stunts the growth of the tree. There fore, the suckers should be taken off when they are so tender that they

Fig. 87.—Lemon tree three years old before pruning in the spring. (Original.)

can be rubbed off with the hand. Rubbing them off when they are very tender prevents knots from forming on the trunk or limbs of the tree, which I believe retards the free flow of the sap, and the suckers will not have yet formed any fibre or hardwood to connect them with the woody part of the trunk of the tree. I believe that every time a knot is formed on the trunk of the tree it becomes to some extent an obstruction in the flow of the sap. The smoother the surface of the channel through which the sap has to flow, the freer the circulation through the limbs, twigs, and foliage of the tree.

In pruning a lemon tree planted nine months in the orchard the tall branches are cut back very short for the next deck or framework

This close cutting is done to develop strength in the crown of the tree before a heavy top growth is developed. Although this tree is only nine months old, some short, healthy wood has been allowed to remain in the crown which was developed in the nursery and in the crown now being developed. These are little fruit limbs which have formed and will during the second year of growth blossom and set some fruit. I have been asked many times if it is best to pick off these blossoms or cut off this fruit. I say no. Let us consider from now on the matter of leaving the fruit spurs and fruit limbs in the crown of the tree which has been developed so that they may grow and produce

FIG. 88.—Same tree as shown in Fig. 87 pruned. (Original.)

lemons in limited quantities while the tree is young. Do not be alarmed if the young trees, one or two years old, begin to show an inclination to bear and develop some fruit. Let them get the habit while they are young. A lemon tree, properly trained and pruned, should bear quite a few lemons when it is three years old. The little limbs will first blossom on the end, bearing from one to three lemons, and then on the limb, back toward the trunk of the tree, fruit spurs will develop and set fruit.

Figure 84 shows a two-year tree before pruning in the spring. The tall limbs should be cut back to from six to twelve inches, depending

upon the fruit line. The fruit line, or deck, is a vertical growth of fruit limbs that will blossom and set fruit on the ends, then bend downward, causing fruit spurs to come on these limbs and bear fruit. Each year a new deck of fruit wood or limbs is developed, and as before stated, this growth should only be cut when it becomes too thick.

Figure 85 shows the same tree two years old pruned ready to begin its spring growth. It is important to go over the two-year trees at least twice during the year, taking out all suckers and cutting back the limbs that have grown out of proportion to the other part of the tree to a

FIG. 89.—Three-year-old lemon tree pruned three times during 1915. (Original.)

point where the growth is round and not smaller than a lead pencil; larger would be better. *Never cut angular wood.* In some cases it will be necessary to take out entire limbs if they have grown too thick, and also to cut those back that have grown in the right place to add to the framework of the tree. Twenty-one limbs were taken from this tree, twelve being too thick, and nine were cut back for building.

Figure 86 is a tree the same age as that in Figure 85 pruned, but larger. It has more of the feathery growth and a well-defined fruiting line.

Figure 87 shows a tree three years old before pruning in the spring. These pictures were taken in January. While the trees are called one, two and three years of age, they lack about three months of being that age. Most trees are coming two or three years old. These trees were pruned three times last year.

Figure 88 shows the same tree pruned. It has been reduced in height considerably, which was done to strengthen the frame. Some growth was taken out of the center where it was too thick.

Figure 89 shows a tree three years old, pruned three times during 1915, or last year. The tree has made some tender growth after the late fall pruning. This picture was taken January 22d, before the tree began its spring growth. It shows a developed fruit line as it

FIG. 90.—Thirteen-year-old lemon tree unpruned. (Original.)

enters its fourth year. Some of the tender growth will commence to develop rapidly early in the spring and so will have to be gone over at least three times to thin out and cut back at proper points, just as was necessary with the two-year tree. A lemon tree at this age, properly pruned and trained, should show a well-defined fruit line.

Figure 90 shows a thirteen-year-old tree unpruned. It was pruned three times the previous year, and the vertical growth showing above the feathery or fruiting line is that which developed from about October to January 22d the following year, or in about three months

When the same tree was pruned, forty-three of these limbs were taken out and seven were cut back because they grew where more fruit bearing wood could be produced. When a lemon tree reaches this age very little cutting back is necessary. Most all of the vertical

growth should be taken out. A tree properly pruned from its infancy is brought to this age without large stubby limbs near the top of the tree. This method of pruning and training of a young lemon orchard will bring the trees to full bearing age without any long bare limbs, devoid of fruit limbs and fruit spurs on the frame of the tree. Great care should be taken not to allow the growth to become too thick. Sometimes it may be necessary to take out a whole limb and open the

FIG. 91.—Showing a tree pruned once late in the spring and the pruning not followed up during the summer. (Original.)

tree a little to let in the air and light so that the fruit-bearing wood in the interior of the tree will bear fruit.

Figure 91 shows a tree pruned once late in the spring and the pruning not followed up during the summer. Much of the growth is wasted by allowing too much of it to become woody. This will have to be taken out. Therefore, time will be lost in the proper building of the frame of the tree and in the development of fruit bearing wood.

SOME GOOD RULES TO FOLLOW IN TRAINING AND PRUNING YOUNG LEMON TREES.

First.—Use good sharp shears so as to make a smooth cut.

Second.—Never cut off a limb over $\frac{3}{4}$-inch thick with the shears. Use a sharp saw, smooth with a knife, and then wax. Every limb which is cut $\frac{7}{8}$-inch and over should be waxed, especially in the training and pruning of a tree up to five or six years of age.

Third.—In cutting out limbs entirely, cut close and smooth, then wax. Do not leave stubs in the tree.

Fourth.—Never cut angular wood. Where a cut is made the wood should be round, no smaller than a lead pencil, and a little larger would be better.

Fifth.—Never crop or shear off ends of fruit limbs. Never shear the tree under any circumstances.

Sixth.—Keep the trees free of water sprouts, especially the trunks of the young trees.

Seventh.—*When in doubt leave it.* That is, when in doubt whether a limb ought to be cut out or cut off, leave it until next time. It can be taken out in the future, if it is necessary, but if cut off, it can never be put back. It is necessary to go over the orchard at least three times a year with the pruning shears.

Eighth.—Never cut out the little fruit limbs which grow in the framework of the tree which has been developed, only where they are too thick.

A very important point which should not be overlooked is the soil. Unless the soil is kept in a good physical condition, manufacturing food for the tree, one can not expect good results. The framework of the tree has been built. On it hangs thousands of fruit limbs, fruit spurs have set, thousands of buds are ready to produce more fruit limbs and spurs, more fruit limbs are continually coming into bearing, and unless the tree is properly and regularly fed one can not expect prolific and continuous fruiting. A lemon tree is very much like a potato in the comparison of the fruit buds with the eyes of the potato. Every bud on the lemon tree is capable of growing fruit limbs and fruit spurs, even down on its trunk to the top of the ground. Keep the food factory in good running order, furnishing the proper diet for the tree. With the proper handling of the soil and the proper training and pruning of the lemon tree, one can develop a tree which will always and indefinitely be a prolific bearer and a profit to its owner.

CROP REPORT AND STATISTICS.

MONTHLY CROP REPORT.

(July 1, 1916.)

By Geo. P. Weldon.

Compiled from the reports of the County Horticultural Commissioners.

County	Almonds (per cent)	Apples (per cent)	Apricots (per cent)	Berries (per cent)	Cherries (per cent)	Figs (per cent)	Grapefruit (per cent)	Lemons (per cent)	Olives (per cent)	Oranges (per cent)	Peaches (per cent)	Pears (per cent)	Plums (per cent)	Prunes (per cent)	Walnuts (per cent)
Alameda	65	#	h	90	h	#	#	#	#	#	#	80	—	30	—
Butte	15	90	h		h	100	100	100	25	100	25	35	35		
Colusa	75	#	h	#	#	100	#	#	#	100	75	75	#	70	75
Contra Costa	70	100	h	#	h	#	#	#	70	#	85	65	70	55	100
El Dorado	#	65	#	#	h	#	#	#	#	#	70	40	40	30	#
Fresno	100	#	h	100	#	100	#	100	100	80	60	#	#	#	#
Glenn	75	50	h	100	h	50	100	100	100	100	90	100	#	70	85
Humboldt	#	80	#	80	h	#	#	#	#	#	—	80	80	80	—
Imperial	#	#			#	70	#	#	#	#	#	#	#	#	#
Inyo	#	85	h	30	#	#	#	#	#	#	60	90	#	#	#
Kern	#	60	h	#	#	100	#	#	100	100	85	60	90	100	#
Kings	#	#	h	#	#	#	#	#	#	#	90	#	#	90	#
Lake	50	50	h	50	h	50	#	#	—	#	50	33	#	25	50
Los Angeles	80	100	h	100	#	60	100	90	80	90	85	75	30	#	70
Madera	35	—	h	#	#	65	#	#	80	#	85	#	#	85	#
Mendocino	60	100	h	50	h	#	#	#	#	#	75	30	#	75	85
Merced	90	#	h	h	#	100	#	#	100	#	70	#	#	#	#
Monterey	75	65	h	40	h	#	#	#	#	#	75	50	25	25	#
Napa		80	h	100	h		#	#	#	#	60	50	80	40	90
Nevada	50	100	h	50	h	50	#	#	—	—	90	60	40	40	20
Orange	#	100	0	100	—	—	100	90	75	100	75	—	100	—	100
Placer	25	100	h	90	h	90	#	100	—	90	75	75	75	#	#
Riverside	90	80	h	#	h	#	100	90	80	75	80	40	#	75	60
Sacramento	65	90	h	100	h	#	100	100	80	95	70	68	65	50	#
San Benito	100	100	h		h	#	#	#	#	#	80	100	#	75	#
San Bernardino	#	50	h	#	h	#	75	90	70	95	50	50	80	80	90
San Diego	70	25	h	100	0	—	100	75	100	100	80	20	25	20	100
San Joaquin	40	80	h	#	h	#	#	#	75	#	75	50	75	50	75
San Luis Obispo	100	90	h	#	h	#	#	#	#	#	90	80	#	95	80
Santa Barbara	#	100	h	#	h	#	100	100	100	100	#	90	#	#	80
Santa Clara	#	60	h	—	h	#	#	#	#	#	75	50	—	55	#
Santa Cruz	#	80	h	75	h	#	#	80	#	#	75	50	—	40	#
Shasta	20	75	h	50	h	75	#	#	25	#	60	30	50	50	75
Siskiyou	#	10	#	40	h	#	#	#	#	#	5	5	5	5	#
Solano†															
Sonoma	25	100	h	75	h	#	#	#	—	#	80	80	75	40	100
Stanislaus	80	75	h	h	h	50	#	100	100	100	85	75	100	100	#
Sutter	75	100	h	100	h	100	#	#	—	#	75	50	75	75	75
Tehama	100	25	h	50	h	—	#	#	60	—	65	75	—	75	#
Tulare	#	100	h	h	#	95	95	90	—	85	88	#	75	95	#
Ventura	—	#	h	#	#	#	—	100	—	90	#	#	#	—	65
Yolo	65	#	h	—	#	—	#	#	—	#	75	80	90	50	#
Yuba	70	100	h	90	h	90	#	90	60	90	60	110	100	90	60

Figures in table indicate condition of crop in per cent, on the basis of 100 as normal.
— Horticultural commissioner has insufficient information for a report.
Not grown commercially.
† No commissioner in county.
h Harvested.

STATISTICS.

Estimated per cent of the total crop of the principal California fruits grown in each of the main producing counties during a season of normal production. Compiled from the reports of the county horticultural commissioners.

County	Almonds (per cent)	Apples (per cent)	Apricots (per cent)	Cherries (per cent)	Figs (per cent)	Lemons (per cent)	Olives (per cent)	Oranges (per cent)	Peaches (per cent)	Pears (per cent)	Plums (per cent)	Prunes (per cent)	Walnuts (per cent)
Alameda	*		14	9						2	*	*	
Butte	12	*		*	3	*	14	*	3	2	*	2	
Colusa	4		*						*	*		*	
Contra Costa	11	*	*	*					*	6	*	*	
El Dorado		*		*					*	3	*		
Fresno			5		53	*	3	*	29			*	
Glenn	*		*								*		
Humboldt		2											
Imperial			*		*								
Inyo		*							*				
Kern		*	*					*	*	*	*	*	
Kings			5						6			*	
Lake	*	*	*						*	8		*	
Los Angeles	2	2	4		*	31	14	26	4	*	3	*	30
Madera	*	*	*		3		2		*			*	
Mendocino		*								*		*	
Merced	*		*		9		*		3				
Modoc													
Monterey	*	12	2	*						*			
Napa	*	*	*	*	*		*		*	4	*	4	
Nevada		3	*	*					*	*	*		
Orange			4			7		10					38
Placer	*	*		3	*		*		6	7	39		
Riverside	3	*	7	*		16	11	14	*	*		*	
Sacramento	6		*	5			5	*	*	18	8	*	
San Benito	*		6	*					*	*	*	3	
San Bernardino		4	4	*		13	7	31	5				2
San Diego	*	*	*			10	5	*	*				
San Joaquin	12		3	25	*		4		8	4	*	*	
San Luis Obispo	*	*	*										
Santa Barbara		*	*	2		*	2						10
Santa Clara	*	*	21	26	*				5	9	18	55	
Santa Cruz		51	3	2					*			*	
Shasta	*	*					*		*	*		*	
Siskiyou		*											
Solano	6		3	10					3	6	16	4	
Sonoma	*	16	*	9	*		5		*	6	*	12	
Stanislaus	6		*	*	5			*	3	*			
Sutter	9			*	3		*		2	*	*	*	
Tehama	*	*	*		*		11	*	*	2	*	*	
Tulare	*		*		6	5	6	13	9		2	4	
Ventura			6			15		2					20
Yolo	11		5		5		3		2	9	4	2	
Yuba	*				2		3	*	*	*	*		

*Less than 2 per cent of State's normal crop grown in county.

THE MONTHLY BULLETIN

CALIFORNIA STATE COMMISSION OF HORTICULTURE.

DEVOTED TO HORTICULTURE IN ITS BROADEST SENSE, WITH SPECIAL REFERENCE TO PLANT DISEASES, INSECT PESTS, AND THEIR CONTROL.

Sent free to all citizens of the State of California. Offered in exchange for bulletins of the Federal Government and experiment stations, entomological and mycological journals, agricultural and horticultural papers, botanical and other publications of a similar nature.

Entered as second class matter December 29, 1911, at the post office at Sacramento, California, under the act of July 16, 1894.

Farmers' Short Courses at the University of California.—The University of California announces that short courses will be given at the University Farm at Davis from October 2d to November 10th. There will be short courses in Agriculture, Horticulture and Poultry Husbandry. During the last three weeks of the short course in Horticulture there will be special courses in citrus and semitropical fruits, viticulture and olives. A course in farm tractors from November 13th to 24th has also been announced. For particulars write to the Agricultural Experiment Station, University of California, Berkeley.—E. J. V.

Seventh National Orange Show.—The dates for the Seventh National Orange Show to be held at San Bernardino have been given by the directors of the Show as February 20 to 28, 1917. The officers of the Orange Show are as follows: President, Ben W. Campton; vice-president, Joseph Ingersoll; treasurer, Joseph Strawser; general manager, F. M. Renfro.—E. J. V.

Citrus Experiment Station.—The contract for the building of the new citrus experiment station of the University of California at Riverside was let on June 13th to the Cresmer Contracting Company.

Wheat in California.—California, once an important wheat state and noted for large bonanza wheat farms, is no longer classed as a wheat-producing state. Twenty years ago it produced 45,000,000 bushels of wheat, shipping much of it to Europe. This year its production will probably be not much more than 4,000,000 bushels, and it will need to ship in from other states 10,000,000 bushels or more to meet its own food requirements.—*June Crop Report, U. S. Dept. of Agric.*

Citrus Canker.—The Louisiana State University has just issued a circular—Circular No. 15—on citrus canker. No doubt California Citrus Growers desiring information on this destructive disease may be able to procure copies of this circular by writing to the Experiment Station at Baton Rouge.—E. J. V.

The National Agricultural Society.—Some of the best known men in the country met April 27th at the Hotel Biltmore, New York City, bringing to a head an important movement for the improvement of agricultural conditions throughout the country by completing the organization of The National Agricultural Society.

James Wilson of Iowa, formerly Secretary of Agriculture in the Cabinets of Presidents McKinley, Roosevelt and Taft, was made president, and Theodore N. Vail of New York, was elected vice president. Mr. Vail is largely interested in agriculture, having founded an agricultural school for boys on his farm in Vermont, which he recently turned over to the state. He has always been interested in agricultural problems and particularly in the education and development of the farm boy.

G. Howard Davison was elected chairman of the Executive Committee. Mr. Davison was one of the founders of the International Livestock Exposition, and is a member of many agricultural and livestock associations. He was until recently president of the American Dairy Shorthorn Cattle Club, and for years was a director of the New York State Fair. He was appointed to the Board of Control of the Geneva Experiment Station on which he served for a number of years.

The directors elected, in addition to Messrs. Wilson, Vail and Davison, are: T. Coleman du Pont of Delaware, John A. Spoor of Chicago, R. V. Lindabury of New Jersey, William H. Moore of New York, Governor Henry C. Stuart of Virginia, Senator James W. Wadsworth of New York, Robert A. Fairbairn of New Jersey, Samuel Insull of Chicago, Charles A. Otis of Cleveland, N. H. Gentry of Missouri, Peter Jansen of Nebraska, Fairfax Harrison of Virginia, Walter A. Johnson of New York and P. C. Long of New York.

Mr. Johnson was also elected treasurer and Mr. Long secretary.

Among others who have been instrumental in organizing the Society were the late James J. Hill of St. Paul, W. K. Vanderbilt of New York, J. H. Wade of Cleveland, Frank O. Lowden of Illinois, Mortimer L. Schiff of New York, William du Pont of Virginia, Ex-senator C. W. Watson of Maryland, V. Everit Macy and W. Averill Harriman of New York.

The following committees were also elected: Executive Committee, Messrs. G. Howard Davison, chairman, Vail, Spoor, Lindabury, Fairbairn and Wilson; Finance Committee, Messrs. Harrison, Insull and du Pont; Auditing Committee, Messrs. Moore, Otis and Wadsworth; Nominating Committee, Messrs. Spoor, Stuart, Jansen, Gentry and Davison; Publication Committee, Messrs. Moore, Vail and Fairbairn.

The society will have in addition to these officers a strong advisory board composed of the deans of some of the leading agricultural colleges, heads of the agricultural experiment stations, department of agriculture men, leading editors of agricultural papers and others.

Permanent headquarters for the society will eventually be established at Washington, D. C. At present offices have been taken at 2 West 45th street, New York City, and from this point the work of organization will be directed. President James Wilson and the other active officials of the organization will therefore be located at the New York offices for the present.

With these men seriously concerned in the organization, and believing that the great problem of the United States today is that of agriculture, the society hopes to become in time an important factor in the national welfare.

There has not been in this country heretofore a really national association of this character. In England and the continent there are several organizations of this kind, among them being the well-known Royal Agricultural Society of Great Britain and the International of Italy. These institutions have accomplished a vast amount of good, but up to this time American agricultural associations have confined themselves to local problems.

It is felt by those responsible for the founding of The National Agricultural Society that there should be in this country a national organization, to which the farmers could look for help and guidance which will be their mouthpiece in agricultural matters of national concern.

ITS PLAN AND PURPOSE.

The National Agricultural Society has been organized for the general advancement of the agriculture of the United States, to promote and encourage those things which are essential to a successful agriculture.

It has been founded to "nationalize American agriculture," and its chief function is to serve as a medium for the concentration and expression of those opinions, experiences and methods resulting from agricultural research, which have been proved by practical experience to be of benefit to the agriculturist.

MEMBERSHIP.

The society makes no restrictions on membership and anyone with a sincere interest in agricultural betterment is made welcome.

Membership classes are divided into annual members, for whom the annual dues are $2, and sustaining members, founders, patrons and benefactors, who support the society in larger amounts. All classes of members are entitled to all of the publications of the society without further charge.

ITS PLATFORM.

It is the intention of The National Agricultural Society to serve as a clearing house of agricultural problems, and a record of agricultural progress, and to act as a nonpartisan sponsor for all national movements leading forward in rural affairs.

It desires to encourage a more intimate relationship between the farmer, the stockman, the agricultural college profession, the agricultural college graduate, and the staffs of the various United States experiment stations.

The first step of the society will be to secure a representative membership, the campaign for which has already been inaugurated.

Through its president, directors, advisory board, and members, the society will keep in touch with agricultural progress and will work through many widely separated agencies. In this work the entire country eventually will be subdivided and as a result of reporting back to headquarters a vast amount of practical and useful information will be secured.

This and other information will be disseminated to all of the society's members throughout the country and the society will be an authoritative source of information on matters within its scope.

The society will send out from time to time communications to its members by which it hopes to make each member an agent for the common good. Under the present plan conventions will be held in various localities which will bring together the best local influences.

The National Agricultural Society recognizes that agricultural progress is becoming more rapid each year, owing to the research and experimental work of The Federal Department of Agriculture and that of the various agricultural colleges and experiment stations of the country. It believes that this work should be made available to the farmers and agricultural students of the United States promptly and in usable form. It has, therefore, projected *The Agricultural Digest* to act as the register and interpreter of this work, as well as the mouthpiece of the agricultural industry of the United States, and the organ of the society.

THE AGRICULTURAL DIGEST.

The *Digest* will:

(1) Report the essentials of the experiment station publications and the research work of the Department of Agriculture, the agricultural colleges and other institutions investigating agricultural problems.

(2) Digest the important articles appearing in the various agricultural papers of the country.

(3) Present instructive feature articles covering all of the important agricultural movements of the country, such as conservation of soils, co-operation, rural credits, and similar matters of national importance.

(4) Support all wise and useful legislation tending to better the condition of the agricultural classes and bring about a closer and more intimate relation between the producer and consumer.

(5) Teach the application of the best modern methods, based on economic principles and practical experience, to agricultural labor; thereby increasing the product of labor without increasing the cost to the consumer.

The Agricultural Digest will be national in its scope and character and will lend its support to all measures making for agricultural progress. It will be in no wise a competitor or antagonist of any local, sectional or other farm paper, but, instead, will co-operate with them for the common good.

ITS CONSTITUTION.

The objects of The National Agricultural Society as set forth in its formal constitution are as follows:

Article II.

The objects of this society shall be as follows:

(*a*) To effect an organization, nonpartisan and nonpolitical, which shall afford a common mouthpiece for the varied and diversified agricultural interests of the country on matters of national concern.

(*b*) To promote the cause of agriculture and its advancement; the maintenance of soil fertility; the breeding of better livestock and the prosperity of rural industries throughout the United States by the mutual self help and fraternity of its members and the encouragement of a community spirit.

(*c*) To co-operate with and assist the public authorities, regularly organized societies, associations and individuals in agricultural matters.

(*d*) To consider systems of rural credits to the end that owners of agricultural lands may secure some of the financial benefits now accorded other industries.

(*e*) To co-operate with legislatures of the various states with the object of securing uniform agricultural legislation non-partisan in character throughout the states.

(*f*) To promote an interest in agriculture and rural activities as the basic industry of the country in the congested centers of population.

(*g*) To co-operate with and assist organized societies, associations, and individuals in matters affecting conservation of natural resources.

(*h*) To encourage co-operation among farmers and to aid in establishing better methods for the marketing and distribution of farm products.

(*i*) To appoint delegates and committees to appear before congress and the state legislatures in support of agricultural interests.

(*j*) To appoint commissions for the investigation of agricultural conditions both in this country and abroad for the common benefit of agriculturalists throughout the country.

(*k*) To own and lease any and all property, real or personal, necessary, convenient or useful for the purpose of this society.

(*l*) To publish such bulletins, magazines, and other literature as the society may deem necessary in the furtherance of its work.—*Agricultural Digest for June, 1916.*

QUARANTINE DIVISION.

FINIS RATIONEM EXCUSAT.

Report for the Month of May, 1916.

By Frederick Maskew.

Four years have elapsed since we first commenced to publish a monthly record of the work and findings of the Quarantine Division of the State Commission of Horticulture. We realized at the outset that it would be an undertaking of dimensions to continue the task of determining the pests intercepted and compile the statistics for this report each month in addition to the rapidly growing volume of routine work at the station; however, we had a definite purpose in mind in so doing, and our persistence has advanced us a long way toward the ultimate goal of this purview. Pertinent among the several reasons that influenced our original decision, was the hope that a reiterated official record of the insect pests and plant diseases we were intercepting would eventually attract the attention of plant inspectors in other countries to the condition of the plant products their counrymen were exporting, and elicit their interest in an attempt to clean up these exports at the point of origin. In this particular direction we have succeeded beyond our most sanguine expectations. Reported findings bred inquiries, inquiries resulted in acquaintance and acquaintance soon established confidence. Adverse criticisms of our methods have practically ceased; our system of procedure is being widely copied and adopted; imports of plant products arrive in much better, cleaner condition, are handled with far greater dispatch and the percentage of rejections is lower than ever before.

SAN FRANCISCO STATION.

Steamship and baggage inspection:

Ships inspected	76
Passengers arriving from fruit fly ports	3,562

Horticultural imports:

	Parcels
Passed as free from pests	105,900
Fumigated	2,628
Refused admittance	101
Contraband destroyed	30
Total parcels horticultural imports for the month	108,659

Pests Intercepted.

From Australia:

Coccid on Kentia palm.

From Azores:

Lepidosaphes beckii, Pseudococcus sp., and fungus on lemons.

From British Columbia:

Chionaspis pinifoliæ on conifer.

From Central America:

Aspidiotus cyanophylli, Aspidiotus palmæ and *Pseudococcus* sp. on bananas.

From China:

Phomopsis citri on pomelos.
Larvæ of Weevil in sweet potatoes.
Aulacaspis rosæ on unknown plant.

From Hawaii:

Diaspis bromeliæ, Pseudococcus bromeliæ and *Saissetia* sp. on pineapples.
Coccus longulus on betel leaves.
Cylas formicarius in sweet potatoes.
Trypetid larvæ in mangoes.

From Japan:

Larvæ of Weevil in sweet potatoes.
Ceroplastes rubens on Camellia.

From New Jersey:

Cerataphis lataniæ on palms.

From Oregon:

Larvæ of *Epochra canadensis* in gooseberries.

From Tahiti:

Fungus on oranges.

LOS ANGELES STATION.

Ships inspected	28	
Horticultural imports:		Parcels
Passed as free from pests		74,956½
Fumigated		313
Refused admittance		5½
Contraband destroyed		4
Total parcels horticultural imports for the month		75,279

Pests Intercepted.

From Alabama:

Pseudococcus sp. on Coleus.

From Arizona:

Weevil larvæ in acorns.

From Central America:

Aspidiotus cyanophylli, Chrysomphalus scutiformis and *Pseudococcus* sp. on bananas.

From Cuba:

Pseudococcus bromeliæ on pineapples.

From Illinois:

Pseudococcus sp. on Coleus.

From Massachusetts:

Euthrips sp. on lemon trees.

From Mexico:

Chloridea obsoleta on tomatoes.

From New York:

Pseudococcus sp. and Aphides on gardenias.

From Ohio:

Orthezia insignis on *Strobilanthus dyerianus.*
Pseudococcus sp. and *Saissetia hemisphærica* on crotons.

From Pennsylvania:

Aphides on Chrysanthemum plants.
Pseudococcus sp. on rose plants.
Chrysomphalus aonidum on Lilies.

SAN DIEGO STATION.

Steamship and baggage inspection:

Ships inspected	27
Fish boats inspected	29
Passengers arriving from fruit fly ports	191

Horticultural imports:

	Parcels
Passed as free from pests	4,160¾
Fumigated	6
Refused admittance	1¼
Contraband destroyed	2
Total parcels horticultural imports for the month	4,170

Pests Intercepted.

From Mexico:

Lepidosaphes gloverii on oranges.

From New Jersey:

Pseudococcus sp., *Pulvinaria* sp., *Chrysomphalus aonidum* and *Ampeloghypter* sp. on orchids.

From Ohio:

Saissetia hemisphærica and *Coccus hesperidum* on crotons.

From Oregon:

Aleyrodes sp. on ornamental plants.

From Wisconsin:

Pseudococcus longispinus and *Coccus hesperidum* on crotons.

EUREKA STATION.

Steamship and baggage inspection:

Ships inspected	5

Horticultural Imports:

	Parcels.
Passed as free from pests	43

SANTA BARBARA STATION.

(No report.)

THE MONTHLY BULLETIN.

CALIFORNIA STATE COMMISSION OF HORTICULTURE

Vol. V. August, 1916. No. 8

PIPING SYSTEM FOR ORCHARD SPRAYING.

By George P. Weldon.

Promptness and thoroughness are the two most important requisites of spraying. The satisfactory control of a serious insect pest or fungous disease can not be accomplished unless the spraying is done at the opportune time, which sometimes arrives when, on account of wet weather, the ground is so soft that the spray truck can not be moved about through the orchard. Such a condition as this has interfered with spraying for scab of pears and apples as well as diseases and insect pests of other trees, practically every spring, in some of our orchards. The solution of this problem is found in the piping system of spraying which enables the fruit grower to treat his trees at any time during the season when rain is not falling.

The cost of installing the piping system is quite heavy and is the factor that prevents its general use. After installation the expense of operation is much less than that of the commonly used gasoline power outfit. Some figures for comparison may be of interest in this connection. Ordinarily three men are required to operate the gasoline power sprayer, two nozzlemen and a man to attend to the team, pump and outfit in general. The usual capacity of a tank is 200 gallons. By working steadily with water handy for filling tanks, 10 tanks or 2,000 gallons per day may be applied. It often requires, for thorough work, 10 gallons of spray for every average sized bearing tree, thus the services of three men are required to spray 200 trees per day, or an average of 66⅔ trees per man. In the E. A. Gammon orchard, which is piped as described later, it is not difficult to force 1,000 gallons of spray per day through each lead of hose. It is stated by Mr. Gammon that 10,400 gallons were applied from 10 leads of hose in one day. To apply the same amount of spray with power sprayers it would require the use of five ordinary machines and at least 15 men to operate them. Counting on an average of 10 gallons per tree, each man holding a hose in the Gammon system would spray approximately 100 trees on an average per day. If quicker service than this was desired an additional number of hose connections could be provided. The amount of spray applied per tree is often less than 10 gallons and depends very largely on the spray being applied, and the pest that it is expected to control.

In order that readers of this article may have as many specific details as possible regarding the piping system of spraying, two systems in use in Sacramento River pear orchards will be described. The first system that was installed, as far as the writer has been able to learn, is that in the Hayward Reed orchard, close to Sacramento, in Yolo County.

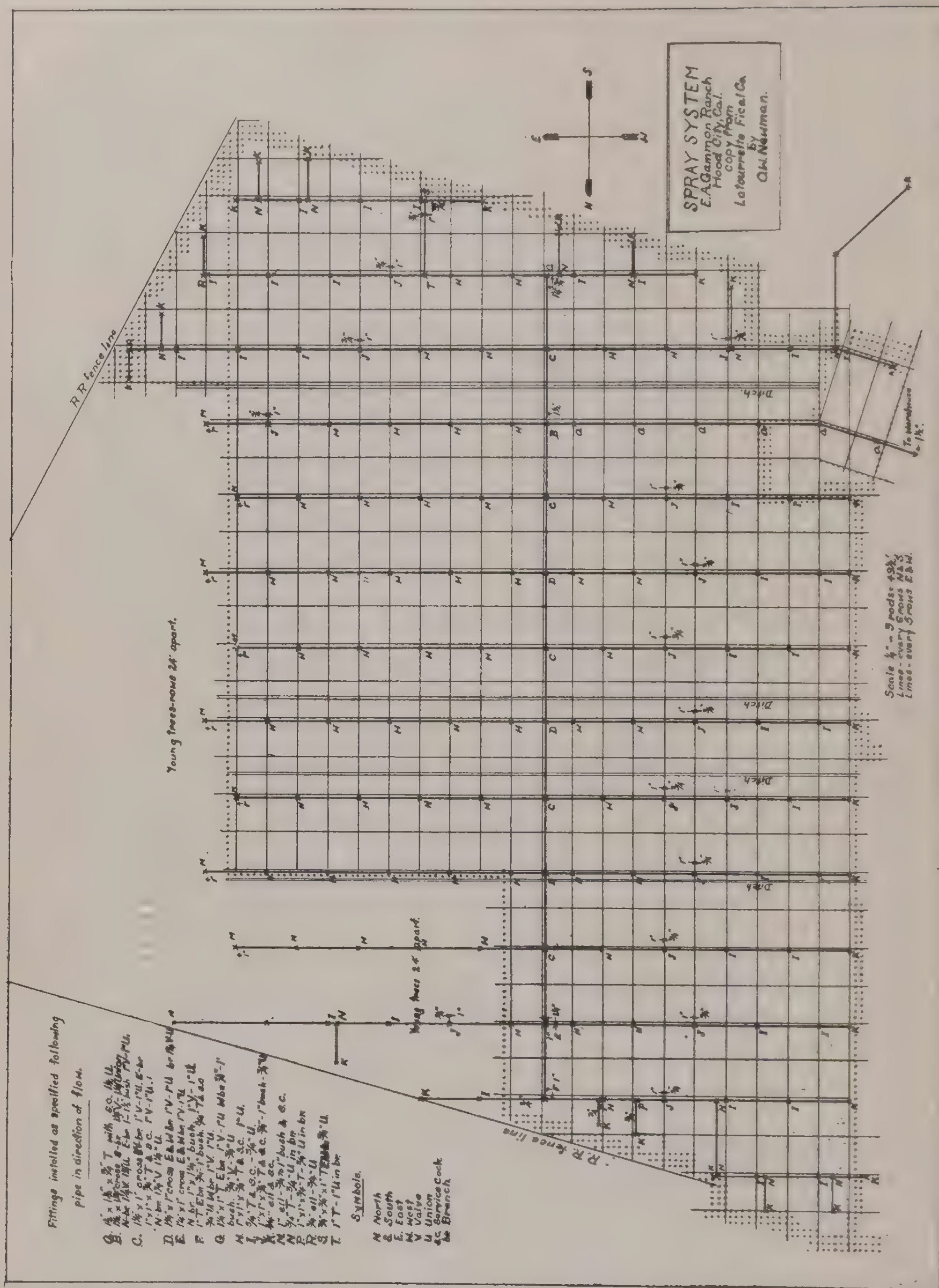


FIG. 92.—Map of underground spraying system in the E. A. Gammon pear orchard at Hood, Sacramento County. A. 1½"x1½"x¾" T with S.C. 1½" U. B. 1½"x1¼" cross S-br. 1¼" V- 1¼" U. N-br. 1¼" V. 1¼" U. E-br. 1"-1½" bush. 1" V-1" U. C. 1¼"x1" cross W-br. 1" V-1" U.E-br. 1"x1"x¾" T & S.C. 1" V-1" U. N-br. 1-¼" V. ¼" U. D. 1¼"x1" Cross E & W br. 1" V-1" U. br. 1¼" V-U. E. 1¼"x1" cross E & W br. 1"V-1"U. N-br. 1"x1¼" bush. 1" V-1" U. F. 1" T E. br. ¾"-1" bush. ¾" T & S.C. ¾" U W br. 1" V 1" U. G. 1¼"x1" T E. br. 1" V-1" U. W br. ¾"-1" bush. ¾" V-¾" U. H. 1"x1"x¾" T & S.C, 1" U. I. ¾" T & S.C.-¾" U. J. 1"x1"x¾" T. & S.C. ¾"-1" bush. ¾" U. K. ¾" E11 & S.C. M. 1" E11-¾" to 1" bush. & S.C. N. ¾" T-¾" U in br. P. 1"x1"x¾" T-¾" U in br. R. ¾" E11-¾" U. S. ¾"x¾"x1" T E W. br. ¾" U. T. 1" T-1" U in br. SYMBOLS.—N—North; S—South; E—East; W—West; V—Valve; U—Union; SC—Service cock; br.—branch. (Copy by O. W. Newman.)

HAYWARD REED SYSTEM.

Like many others among the pear growers, Mr. Reed experienced great difficulty in getting his orchard sprayed at the right time each spring, because of late rains and wet soil. The dread disease, scab, which

requires an early spray for its control, often played havoc with the fruit crop because of the impossibility of spraying early. Being a man of a progressive nature, Mr. Reed conceived the idea, seven years ago, of laying pipes throughout his orchard through which the spray could be forced from a central pumping plant, and spraying could be done at any time that men could walk among the trees. Since that time he has demonstrated that such a system is practical, efficient and economical in its operation, and as the gasoline power outfit has superseded the old hand pump, so it is safe to predict that in the larger orchards at least, the piping system will supersede the gasoline power outfit.

At present the Reed equipment consists of a "Bean Giant" 4-cylinder pump located in the center of his orchard, and run by an electric motor. From the pump a $\frac{3}{4}$-inch pipe is laid 18 inches deep, and extends throughout the entire length of the orchard in an easterly and westerly direction. Every fourteen rows apart and at right angles to the main pipe other $\frac{3}{4}$-inch pipes with service cocks every fourteenth tree extend in a northerly and southerly direction across the orchard. These pipes are laid midway between the tree rows, and are deep enough so that there is no danger of a plow disturbing them. The rows of trees are $17\frac{1}{2}$ feet apart and the trees in rows 20 feet so that a 200-foot lead of hose attached to a service cock will reach and handily spray 196 trees. Two men are required to handle each hose and herein lies a possible weakness in the Reed system which can be remedied by laying the pipes closer together and providing more service cocks. In the Gammon system, a description of which follows, this difficulty has been overcome, and only one man is required to handle a single lead of hose, which is only 75 feet.

GAMMON SYSTEM.

Fig. 92 is an accurate map of the underground spraying system in E. A. Gammon's orchard, as it was originally planned. A slight modification of this system was finally adopted and will be explained later.

The heavy lines in map indicate the pipe lines extending throughout the 100 acre orchard, and the light lines represent tree rows. The pumping plant is located in the extreme southwestern corner of the picture. A "Bean Giant" 4-cylinder pump (Fig. 93*c*) is used to force the spray throughout the system, the power for running the machinery being derived from an electric motor. Water is raised from the river with a $1\frac{1}{2}$-inch centrifugal pump through the pipe *D* into the tank *A*. The dilute insecticide or fungicide flows by gravity through pipe *E* into delivery tank *B*, which is equipped with a powerful agitator that keeps the spray well mixed. From tank *B* the liquid is pumped into the system at a pressure of 350 pounds at the pump. This pressure is sufficient to give a strong spraying pressure at nozzles at the points farthest away from the pumping plant, as illustrated in Fig. 94, which shows cherry trees being sprayed at a distance of approximately one-half mile from the pump. As the specifications do not show clearly in the cut they are printed underneath. From these it will be seen that the pipe running from the pump to point *B* is $1\frac{1}{2}$ inches in diameter. From this point it is reduced to $1\frac{1}{4}$ inch, later from $1\frac{1}{4}$ to 1 inch, and $\frac{3}{4}$ inch at extremities, all service cocks being $\frac{3}{4}$ inch.

In the figure it will be seen that the original plan was to have pipes laid every twelve rows in an easterly and westerly direction throughout

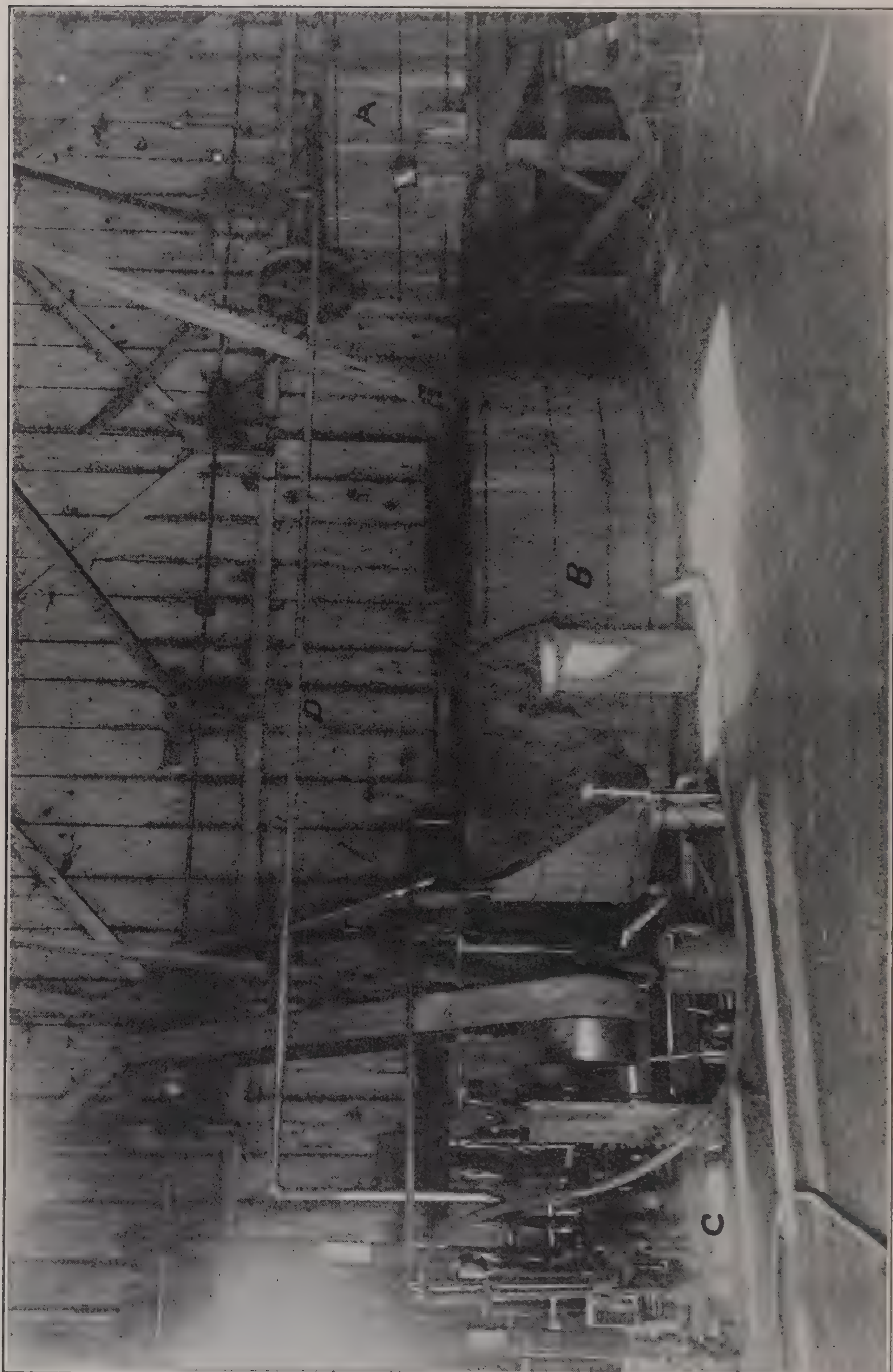


Fig. 93.—Showing the interior of the pumping plant. (Original.)

the orchard, these pipes branching from a main lead in the center of the orchard, extending throughout its length in a northerly and southerly direction from point B in main lead from warehouse. Service cocks were to have been placed every 10 rows apart. This plan required the use of 125-foot leads of hose which were found to be too long for one man to handle. In order that this difficulty might be overcome the pipes were laid 8 rows or 8 rods apart with hose connections every 5 rows, so that 40 trees are now sprayed from each lead which is only 75 feet and which can be readily handled by one man. The depth of pipes is about 18 inches.

Fig. 94.—Spraying cherry trees one-half mile from the pumping station. (Original.)

COST OF INSTALLATION.

Mr. Gammon states that the cost of his system, exclusive of the motor, was about $5,000. This cost may seem prohibitive to some, but when the permanence of the system, the saving in cost of spraying, the saving in time and material, and general efficiency are considered, it is probable that any paying orchard of 50 acres or more will justify the installation.

Mr. Gammon has pointed out only one difficulty that he has encountered since beginning operations with his plant last spring, and that is leakage in the valves which are rapidly damaged by the grinding of a sulphur spray forced through the pipes under high pressure. The atomic sulphur was used extensively by Mr. Gammon in spraying for the control of scab, and its use resulted in the damage as described. No doubt arsenate of lead or any other granular spray held in suspension would have the same tendency, which will undoubtedly be remedied in time by specially constructed valves.

THE IMPORTANCE AND PREVENTION OF WOOD DECAY IN FRUIT TREES.

By W. T. Horne,
Associate Professor of Plant Pathology, University of California, Berkeley.

In large forest trees the decay and disappearance of wood in the center give us the well-known hollow trees. Such trees may live for many years but are liable to be broken down or blown over. In our orchards also wood decay is common. Decayed orchard trees may live for some years and bear reasonable crops, but usually a heavy load of fruit breaks off one limb after another and the tree becomes a worthless stub. Peaches are especially subject to rapid loss in this way, but the present discussion applies to all our fruit trees. The decays considered in this paper are those which start from some surface of dead bark or wood and spread through the center of trunk and limbs without affecting, at least for some time, the bark and cambium.

This kind of decay should not be confused with the oak fungus disease which affects primarily the roots but may spread up some little distance into the trunk. It affects perfectly sound and healthy roots and kills the bark, causing it to decay in a characteristic manner, and then spreads into the wood causing a soft, light-colored decay. In contrast with the oak fungus disease, the common wood decays do not attack perfectly sound healthy trees with unbroken bark, but the rot starts from some exposed wood and then works up and down through the center of the tree.

IMPORTANCE OF WOOD DECAYS.

Fruit trees with decayed centers may bear heavily but usually such trees rapidly become cripples. Not only is the carrying strength reduced but there is good evidence that many of the dead limbs seen in orchards are due to wood decay which has worked outward to the bark. Mr. C. J. Rodgers, of Watsonville, working in our laboratory, has shown that the so-called sappy bark disease of apples is due to one of these fungi. That such decays are common is generally conceded, but no definite data have been available. Accordingly Mr. W. W. Thomas made careful counts in representative orchards in three regions—coast valley, interior valley, and foothills. While the results secured may not be at all final, they clearly show several facts with respect to stone fruits. First, contrary to anticipation, wood decays are more prevalent in the hot interior valleys and foothills than in the cooler and more humid coast valleys. The winter moisture in the three regions is not very different, while the more frequent sunburn and wider cracking of large pruning wounds doubtless account for the facts found. Also in the orchards examined there had been less grafting over of bearing trees in the coast region. Second, it appears that more than half the stone fruit trees of bearing size in California are certainly affected with wood decay. Third, not much more than 2 per cent of stone fruit trees are free from sunburn or large wounds. Fourth, by far the largest part of infection comes from sunburn, large pruning wounds, or grafting over stubs. Fifth, fully two-thirds of the decay is caused by the common oyster shell fungus, *Polystictis versicolor*. A dozen

Fig. 95.—Orchard tree in last stages of decay caused by infection by fungi in large pruning wounds. (Cal. Agrcl. Exp. Sta.)

other fungi will probably include nearly all of the common wood decay forms in orchards.

We believe wood decay is a trouble of stupendous importance to the California fruit industry. Professor Wickson says: "There are instances in the earliest-settled parts of the state, where peach trees above fifty years old are still vigorous and productive. * * * Some trees have, in fact, gone along in thrift * * * because they have never been allowed to sunburn, * * * have never been pruned with an axe, and have never lost a limb nor had a wound into which decay could penetrate and descend to the root."

CAUSE OF WOOD DECAY.

Wood decay does not set in because a tree is old or because it is weakened by lack of food or water. Neither is it a natural process necessarily following exposure to air and moisture. Serious wood decay is due to infection by any one of several fungi which gain entrance at some point where the wood is exposed or where the bark is dead. The fungus grows in the wood, digests it and uses it up, finally leaving only a little ash. This process of digestion constitutes decay. Infection must take place from spores which fall on dead bark or into cracks of wounds. These spores are formed on definite bodies, of which the brackets or oystershell-like structures are examples. The spore-bearing brackets grow almost entirely during winter, so spores will not be scattered during the dry summer. The spores must lodge in a moist crevice in order to grow and establish the fungus in the wood.

TREATMENTS.

Prevention of ordinary wood decay depends wholly on protecting exposed wood from infection by spores of these fungi. Abundant moisture is doubtless also necessary.

Measures will vary according to the kind of trees to be dealt with.

First, for small trees just planted the greatest importance attaches to shaping the tree so that later there will be no need to remove large limbs—in other words, get a simple framework. The tree should also be shaped for strength—so that neither the load of fruit nor orchard operations will be likely to break off large limbs. Wounds should be treated as recommended below, but it appears that wounds which heal over in one year rarely become infected.

Second, trees of some size which have wounds and are liable to infection but are still apparently sound. According to our studies this will include a little less than half our bearing stone fruit trees. All horticultural procedure which I have seen recommended is inadequate for protecting these trees and I take the liberty of suggesting a method on the basis of our present information.

A. When a cut or wound is made exposing the wood of a tree it should be wet with a germicide. This should be done immediately or as soon as the surface has dried and before cracks have formed.

B. Immediately after disinfection, as soon as dry enough, the wood should be covered with some sealing paint to prevent cracking as far as possible.

C. This process must be repeated for all wounds every year until they are healed over. The reason for this is that no sealing material can be trusted to last more than one season.

FIG. 96.—Orchard tree with spore-bearing bodies or brackets of the fungus, *Polystictis versicolor*. Infection at cuts marked with tag. (Cal. Agrl. Exp. Sta.)

D. This operation should be done in late summer or fall in California. The reason for this is that cracks at this time will be at their widest and some spores may have gotten in. These must be killed and the places for entrance of others closed.

For the disinfectant (A) I recommend corrosive sublimate, one part to 1,000 of water by weight. Corrosive sublimate is a poison and must be used carefully; it must not be put into a metal bucket nor come in contact with any metal or the solution will be spoiled. Wooden buckets or enameled ware without breaks may be used.

For the sealing paint (B) I recommend asphaltum softened with benzine to make a rather thick paint. This preparation is said to make a covering material which does not become brittle on drying but becomes plastic in hot weather. Hot asphaltum may also be used applied as a paint.

Third, trees already infected with decay are not to be cured by the above method. They are subjects for tree surgery, which is entirely too large a topic for this paper. Tree surgery in the orchards may sometimes pay if wisely done. I can not refrain from calling attention to three points: (*a*) wood decays are greatly favored by excessive moisture, therefore make all cavities so that they will drain perfectly and remain as dry as possible; (*b*) where decayed wood is removed use disinfectant freely on the wood surfaces and paint as recommended for wounds; (*c*) use cement only for support, never for sealing up a cavity. There will rarely be any occasion for its use in orchard trees; (*d*) the principal measures with decayed orchard trees should be the placing of strong supports to prevent breaking down. If strong devices not injurious to the tree are chosen, decayed trees may possibly be kept in profitable bearing for a considerable number of years.

THE CAROB.

(*Ceratonia Siliqua.*)

By C. W. Beers, County Horticultural Commissioner, Santa Barbara, Cal.

For several years the writer has been attempting to interest the farmers of California in the above forage tree, and the demand for some available literature on the matter has led to the preparation of this paper.

WHAT IT IS.

The carob is an evergreen tree, growing from 25 to 30 feet in height, and old trees are reported as forty inches in diameter. The tree is long lived, comes readily from seed and grows with little care after it is once established. In Santa Barbara there are a number of trees planted eighteen years ago, that are from 15 to 18 feet high. They are 15 feet apart in the row and the branches are interlocking. One tree from the same lot of seedlings has a spread of over 20 feet and is 30 feet in height. The carob belongs to the Leguminosæ and besides yielding a large amount of highly nutritious forage it enriches the soil by storing up nitrogen through the roots.

ADAPTABILITY.

The carob will grow where other plants make a very poor showing. On high, dry, rocky points, by roadsides, along drives, bordering water-courses, anywhere where vacant spots are to be found, there this beautiful glossy foliage tree may be grown, adding to the landscape attractions and every year bearing an abundance of high grade forage. It will endure neglect after once established, and can be planted 60 to 100 to the acre where soil conditions are moderately favorable. A recent visitor to Algeria tells me he saw the carob everywhere. In the lower fertile lands were found fruit trees and crops; on the next higher lands grapes were carefully tended, but on the high dry places the carobs were planted and made a splendid growth.

G. P. Rixford has a record of a carob that grew in a rock crevice at Campo Seco, Calaveras County. He says: "It had bid defiance for many years to the sulphur fumes from the neighboring copper smelter which had killed every vestige of vegetation in the vicinity, except the poison oak—*Rhus diversiloba*. It finally succumbed, not to the acid fumes, but from lack of moisture after the little soil in the crevice had been washed out by rains, leaving the roots bare."

Thousands of acres of our own pasture lands, now averaging less than a ton of indifferent forage, can be made to produce upwards to five tons of carob pods.

PRODUCTIVITY.

Dr. Aaronshon, of Palestine, who attended the Fresno convention in 1912, said that seedling trees will produce an average of 350 to 500 pounds per tree. Twenty trees to the acre will thus produce three and a half to five tons each year. He reports grafted trees, eighteen years old, bearing 900 to 1,100 pounds each. When one reflects that the carob is easily grafted, the possibilities of a pasture of carobs makes the industry quite worth trying out.

NUTRITIVE CONTENT.

Pods from six seedling trees now growing in Santa Barbara were sent to the United States Department of Agriculture, Washington, and the following analyses were reported:

	A	B	C
Gillespie	27.14	13.78	91.94
Gould, No. 38	24.82	15.02	89.98
Gould, No. 27	23.39	15.65	92.28
Gould, No. 24	30.20	13.16	91.84
Gould, No. 18	32.58	12.57	90.24
Gould, No. 9	30.34	14.31	92.00

A—Sucrose per cent.
B—Reducing sugars per cent.
C—Dry substance per cent.

In this report, No. 18 shows a sugar content of 45.15 per cent. No. 9, 44.65 per cent sugar. No. 24, 43.36 per cent, and the Gillespie tree gave 40.92 per cent. The poorest of them is a very rich forage product. Dr. Aaronshon says the pods carry, in addition to the sugar content, a protein supply of 7 to 8 per cent, and in the experiment station record No. 10, for June, 1905, will be found the analysis of a

carob pod that yielded 43.57 per cent sugar and 15.22 per cent protein; but allowing only an 8 per cent of protein and 45 per cent sugar and we have the following most interesting and remarkable series of comparisons.

COMPARISONS.

Wheat is a rich ration, running higher than the carob, pound for pound, but to equal 5 tons per acre of carob pods, wheat must yield three tons of grain to the acre, which is out of the question.

Alfalfa is a splendid feeding product, and stores up nitrogen in the soil while producing the hay. Compared with the carob at 45 per cent sugar and 8 per cent protein, the ground must produce 5 tons per acre, and that on rocky, hilly places, without irrigation and without cultivation. Besides, the carob is one of those trees whose rootlets store up nitrogen in the soil.

We Californians feed quantities of barley, both as a grain ration and as hay, and to make a crop we require good soil, good seasonal conditions, and when threshed, to equal five tons of carob pods, each acre must yield 3½ tons of sweet, dry, first-class barley.

Bean straw is carefully husbanded, baled and housed, and sold at a price that brings good returns; but to equal 5 tons of carob pods each acre must yield 6 tons of bean straw.

It requires 30 tons of carrots to provide the same elements found in 5 tons of carob pods. Corn and cob ground requires 3 tons to the acre to equal the product of an acre of carobs. Corn meal must weigh 2½ tons to equal in food product 5 tons of carobs.

Oats are found to be a great ration for milch cows, but if the crop is to keep pace with carobs, there must be delivered at the sacking shoot three tons of grain per acre or of good clean oat hay the land must yield four tons.

Men pay good prices for beet tops to sugar factory people, but to equal the acreage of the carob each acre of beets must furnish 38 tons of tops. It is difficult to realize the economic importance of such a product. It requires 3½ tons of cottonseed meal to equal the acre product of carobs. For human food, it is richer than cow's milk, pound for pound.

FEEDING.

Horses, cattle, sheep and hogs take readily to the pods, and turkeys soon learn to fly into the tree, tear off the pods, break them and eat them. Chickens will readily feed on the pods when broken up. The Arabs feed the pods to their fine horses. The carob is the main forage for the English cavalry horses in Malta and for the tram horses in Naples, while it is a common sight to see the London cabby give his horse a feed of the brown pods while waiting for a customer. The island of Cyprus grows large quantities of this forage and it constitutes its largest export.

The carob is a splendid avenue tree and hundreds of California farmers could add very materially to their forage supply by planting these trees where shade and ornamental trees are desired.

FEEDING VALUE.

Dr. F. W. Woll, Professor of Animal Nutrition, University of California, at the Davis Farm, carried on a feeding test with calves. One bunch of calves received as their grain portion, ground milo and ground barley, half and half; the other bunch receiving an equal amount of crushed carob pods and ground milo, half and half. This experiment extended over a period of thirteen weeks, and at the close of the period, those fed on milo and barley had averaged a gain of 1.70 pounds per day; while those fed on the carob pods and milo averaged 1.81 pounds. Those fed carobs required more hay than the others, so, taking it altogether, the carob showed values equal to ground barley. This test was made with pods from seedling trees, the sugar test being no higher than those mentioned above, and probably, much below that average.

PROPAGATION.

The seeds come readily. By planting the seed pods on edge, close together, in a sprouting-box, with a slight covering of soil, there will be a succession of seedlings, covering two or three years. This method seems to protect the young seedling from the damping-off fungus, that otherwise causes great loss of the young plants. There seems to be a ferment in the pod that protects the early growth. Seeds stripped from the pod and treated with hot water come quickly, but these young plants are very susceptible to the damping-off fungi.

I. L. Knudson, in the Journal of Biological Chemistry, shows that tannic acid is toxic to a large number of fungi. In the early ripening period of the carob, tannic acid is present in large proportions, making the pod very bitter and astringent, and this suggests to my mind that this tannin may remain in the pod to an extent sufficient to inhibit the deadly action of the damping-off fungi on the young seedlings, when the pod itself is planted. In the Journal American Chemical Society, F. M. McClenahan has shown that in the young walnut a very thin seed coat separates the tannic acid, so abundant in the walnut shell, from the fatty substance of the walnut meat; doubtless placed there to protect the fats from the action of the fungi that would destroy them. It has been shown that the tannic acid of the date, persimmon, banana and olive, is not removed by the ripening process, but is sealed up in some manner that renders it insoluble during the process of mastication, so that although the fruits are delicious to the taste, the tannin remains in the fruits. While the role that fats and tannin play with reference to each other may not be known, is there not a suggestion in the findings of Knudson and McClenahan that, possibly, one relation between them is the inhibition of fungus action of fats and sugars during the formative periods? and, then, later, the destruction of damping-off fungi at the period of germination?

Possibly this may account for the fact that seedlings grown from planting the entire seed pod are immune from damping-off fungi, while those from cleaned seeds are very apt to be destroyed by them.

GRAFTING AND BUDDING.

The tree is easily budded or grafted and the union appears very intimate. Grafted and budded trees bear earlier than seedlings and produce heavier crops. Only by this method can the nutritive content

be determined beforehand, as seedlings do not come true to product. Also the carob is diœcious and in seedling trees there is an excess of staminate trees, and by budding or grafting this can be controlled. It has been found that by budding a single branch of a pistillate tree to a staminate bud, there will result an abundance of pollen to fertilize all the balance of the tree, thus making every tree a fruit bearer.

TEMPERATURE RANGE.

Eighteen degrees of frost does not injure the carob to any extent. Frost conditions that did marked damage to citrus trees made no impression on carobs growing within a few feet of them.

CONCLUSION.

And what more shall be said? Do we advocate planting carobs instead of grains? Shall we plow up our alfalfa and put out this thrifty tree? Are we proposing to revolutionize present good systems of farm procedure? Not at all. But we do urge and expect that the good sense of those who may read this will induce some of them to make a respectable planting of this tree in places where now there is small return, and watch the development.

BALLING DEGREE OF FRUIT JUICES.

By W. V. Cruess,

Assistant Professor of Zymology, University of California, Berkeley.

The fruit standardization law requires that grapes for interstate shipment should show 17° Balling (16° in the case of Emperor). The "Balling degree" represents the pounds of solids in one hundred pounds of clear juice. As this is nearly all sugar, it is often called the "Sugar degree or percentage."

This degree is very easily determined by means of an instrument called variously a *Balling saccharometer*, a *sugar spindle*, or a *hydrometer*. The juice of a representative sample is obtained by crushing the fruit and straining through cheesecloth. This strained juice is placed in a tall glass or metal cylinder and the saccharometer inserted. The Balling degree is then read off the scale on the stem of the floating instrument. If the liquid is dense, that is, contains much sugar, a large part of the stem of the instrument will be above the surface; if light, that is, containing less sugar, the instrument will sink lower. The position of the saccharometer in the cylinder of juice is shown in the figure.

In order that the test shall be reasonably accurate, certain precautions are necessary.

PRECAUTIONS.

The cylinder used to hold the juice should be wide enough so that the Balling saccharometer will float freely. If too narrow, the bulb will be attracted by the walls and the test will not be accurate. For the ordinary saccharometer, a cylinder one and one-half inches in diameter by twelve inches in height is a suitable size.

The saccharometer should be cleaned thoroughly and dried with a soft cloth before using. Grease or sugar on the stem will spoil the accuracy of the test.

The sample of juice should be relatively free from coarse particles of pulp. If it is carefully strained through cheesecloth, it will be sufficiently clear.

In order that the divisions of the scale may be read sharply, the surface should not carry foam or bubbles. A clean, smooth surface is easily obtained by filling the cylinder to overflowing and then pouring out an inch of the juice.

The reading of the scale is made at the general level of the surface of the liquid and not at the top of the film of liquid which tends to climb up the sides of the stem. Consult the accompanying figure.

Read the saccharometer along the line "a . . . a."

The reading of the saccharometer is affected to an important degree by temperatures above or below 60° F. Roughly, for every three degrees Fahrenheit above 60° F. a correction of .1° Balling must be added, and conversely, for every three degrees Fahrenheit below 60° F., a correction of .1° Balling must be subtracted. The accompanying table gives the corrections to be made for temperature.

The temperature of the juice is taken by inserting a chemical Fahrenheit thermometer. It requires about one minute for the thermometer to show the correct temperature.

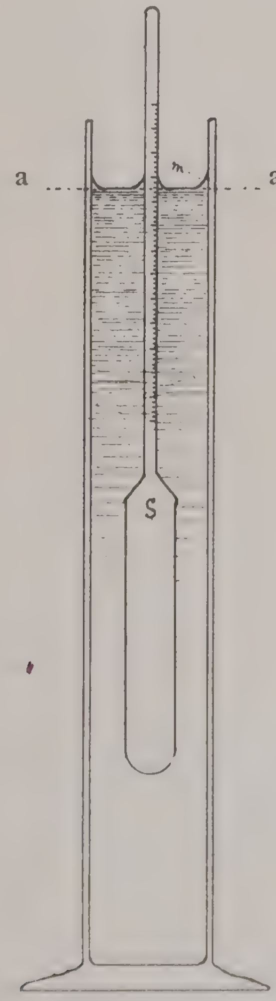


FIG. 97.—Reading the Balling saccharometer. (Cal. Agrcl. Exp. Sta.)

TEMPERATURE CORRECTIONS FOR BALLING SACCHAROMETER.

	Temperature Fahrenheit degrees	Degree Balling					
		5°	10°	15°	20°	25°	30°
To be subtracted from observed reading.	50	.20	22	.24	.26	.28	.30
	52	.18	.19	.21	.22	.23	.24
	54	.15	.16	.17	.18	.18	.19
	56	.09	.10	.11	.11	.11	.12
	58	.05	.06	.07	.07	.07	.07
	60						
To be added to observed reading.	62	.08	.08	.09	.09	.09	.09
	64	.14	.15	.17	.17	.17	.17
	66	.20	.22	.24	.24	.24	.24
	68	.26	.29	.31	.31	.31	.31
	70	.32	.35	.37	.38	.38	.39
	72	.38	.42	.44	.44	.44	.44
	74	.46	.50	.51	.52	.52	.53
	76	.53	.57	.60	.62	.62	.64
	78	.60	.64	.66	.68	.68	.70
	80	.68	.72	.74	.76	.76	.78
	82	.76	.78	.82	.84	.84	.86
	84	.86	.87	.92	.94	.94	.96
	86	.96	.99	1.03	1.05	1.05	1.07
	88	1.06	1.11	1.13	1.17	1.17	1.19
	90	1.17	1.22	1.24	1.30	1.30	1.32
	92	1.26	1.32	1.34	1.40	1.41	1.43
	94	1.36	1.42	1.45	1.49	1.50	1.52
	96	1.46	1.52	1.55	1.58	1.58	1.60
	98	1.56	1.62	1.65	1.68	1.68	1.70
	100	1.66	1.72	1.77	1.79	1.80	1.82
	102	1.76	1.82	1.87	1.92	1.92	1.95

The necessary correction is found in the column showing the Balling degrees nearest to that observed and on the line opposite the observed temperature. Corrections below 60° are subtracted; those above, added.

Example of Temperature Above 60° F.

Temperature of juice .... 88° F.
Balling of juice .... 23°

Twenty-five degrees Balling in the table is the figure nearest the indicated test of 23°. Therefore, under column 25° B. of the table and opposite 88° F. will be found the figure 1.17°. Add this to 23° and 24.17° B. will be the true Balling degree of the juice.

In tabular form, the method of correcting is

Indicated Balling .... 23.00°
Temperature .... 88.00° F.
Correction to be added.. 1.17° B.
Corrected reading..........23.0 + 1.17 = 24.17° Balling

Example of Temperature Below 60° F.

Temperature of juice	56° F.
Balling of juice	18°

Under column 20° B. and opposite 56° F. is found .11°. Subtract this from 18° and the corrected reading will be 17.89° B.

Equipment.

The Balling saccharometer should be one that is standardized at 60° F. and should have a scale reading from 0° to 30° B. in tenths of a degree. A Fahrenheit chemical thermometer graduated from 0° to 212° F. is a convenient type for testing the temperature of the juice. A metal or glass cylinder approximately 1½ inches by 12 inches is suitable for holding the sample to be tested. The instruments and the glass cylinder can be obtained from any large chemical supply firm in San Francisco or Los Angeles direct, or through a local druggist. A tin or brass cylinder can be made by any tinsmith or plumber, and because of its greater durability is preferable to a glass cylinder.

CROP REPORT AND STATISTICS.

MONTHLY CROP REPORT.

(August 1, 1916.)

By Geo. P. Weldon.

Compiled from the reports of the County Horticultural Commissioners.

County	Almonds (per cent)	Apples (per cent)	Apricots (per cent)	Berries (per cent)	Cherries (per cent)	Figs (per cent)	Grapefruit (per cent)	Lemons (per cent)	Olives (per cent)	Oranges (per cent)	Peaches (per cent)	Pears (per cent)	Plums (per cent)	Prunes (per cent)	Walnuts (per cent)
Alameda	65	#	h	90	h	#	#	#	#	#	#	80	30	30	90
Butte	15	90	h	-----	h	100	100	100	25	100	30	70	35	35	#
Colusa	75	#	h	#	#	100	#	#	#	100	75	75	#	65	75
Contra Costa*	70	100	h	#	h	#	#	#	70	#	85	65	70	55	100
El Dorado	#	65	#	#	h	#	#	#	#	#	80	60	40	40	#
Fresno	100	#	h	h	#	100	#	100	100	80	60	#	#	#	#
Glenn	100	100	h	100	#	80	100	100	100	100	100	100	#	100	100
Humboldt	#	80	#	90	h	#	#	#	#	#	90	80	80	90	90
Inyo	#	95	#	#	#	#	#	#	#	#	60	90	#	#	#
Kern	#	60	h	#	#	100	#	#	100	100	85	25	90	90	#
Kings	#	#	h	#	#	#	#	#	#	#	90	#	#	90	#
Lake	50	50	h	50	h	50	#	#	—	#	50	33	#	25	75
Los Angeles	80	100	h	100	#	60	100	90	80	90	80	75	30	#	70
Madera	35	50	h	#	#	60	#	#	80	#	85	#	#	85	#
Marin	#	25	h	100	h	#	#	#	—	#	30	100	100	100	#
Mendocino	60	100	h	h	h	#	#	#	#	#	75	30	#	85	85
Merced	90	#	h	h	#	90	#	#	90	#	70	#	#	#	#
Modoc	-----	45	0	80	0	#	#	#	#	#	0	0	0	0	#
Monterey	75	65	h	50	h	#	#	#	#	#	50	50	25	25	#
Napa	-----	80	h	100	h	-----	#	#	#	#	60	50	80	40	90
Nevada	50	100	h	50	h	50	#	#	—	100	90	60	40	40	25
Orange	#	100	h	h	-----	-----	100	100	75	100	75	-----	h	-----	100
Placer	25	100	h	90	h	#	#	100	—	90	75	70	75	#	#
Riverside	90	75	h	#	#	#	100	90	75	75	80	40	#	75	60
Sacramento	65	90	h	100	h	#	100	100	80	95	70	68	65	50	#
San Benito	100	100	h	-----	h	#	#	#	#	#	80	100	#	60	#
San Bernardino	#	50	h	#	h	#	75	90	70	95	60	50	80	80	90
San Diego	70	25	h	100	0	—	100	75	100	100	80	20	25	20	100
San Joaquin	50	80	h	h	h	#	#	#	75	#	75	70	75	50	75
San Luis Obispo	100	90	h	#	#	#	#	#	#	#	90	85	#	95	90
Santa Barbara	#	100	h	#	h	#	100	100	100	100	#	90	#	#	80
Santa Clara	#	60	h	—	h	#	#	#	#	#	75	50	—	55	#
Santa Cruz	#	85	h	75	h	#	#	80	#	#	80	70	—	50	#
Shasta	20	75	h	h	h	75	#	#	20	#	60	30	50	50	75
Siskiyou	#	10	#	40	h	#	#	#	#	#	5	5	5	5	#
Solano†	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Sonoma	25	100	h	75	h	#	#	#	-----	#	80	80	75	40	100
Stanislaus	80	75	#	#	#	100	#	100	100	100	85	85	100	100	100
Sutter	75	100	h	100	h	100	#	#	—	#	75	50	75	75	75
Tehama	100	25	h	50	h	-----	#	#	60	-----	65	75	-----	75	#
Tulare	#	100	h	h	#	95	95	90	85	85	80	#	75	95	#
Ventura	100	—	h	—	h	#	—	100	—	100	—	—	—	—	65
Yolo*	65	#	h	-----	#	-----	#	#	-----	#	75	80	90	50	#
Yuba	70	100	h	h	h	90	#	90	60	90	60	110	100	90	60

Figures in table indicate condition of crop in per cent, on the basis of 100 as normal.
— Horticultural commissioner has insufficient information for a report.
Not grown commercially.
* No report since July 1st.
† No commissioner in county at present.
h Harvested.

STATISTICS.

Estimated per cent of the total crop of the principal California fruits grown in each of the main producing counties during a season of normal production. Compiled from the reports of the county horticultural commissioners.

County	Almonds (per cent)	Apples (per cent)	Apricots (per cent)	Cherries (per cent)	Figs (per cent)	Lemons (per cent)	Olives (per cent)	Oranges (per cent)	Peaches (per cent)	Pears (per cent)	Plums (per cent)	Prunes (per cent)	Walnuts (per cent)
Alameda	*		14	9						2	*	*	
Butte	12	*		*	3	*	14	*	3	2	*	2	
Colusa	4		*						*	*		*	
Contra Costa	11	*	*	*					*	6	*	*	
El Dorado		*		*					*	3	*		
Fresno			5		53	*	3	*	29			*	
Glenn	*		*								*		
Humboldt		2											
Imperial			*		*								
Inyo		*							*				
Kern		*	*					*	*	*	*	*	
Kings			5						6			*	
Lake	*	*	*						*	8		*	
Los Angeles	2	2	4		*	31	14	26	4	*	3	*	30
Madera	*	*	*		3		2		*			*	
Mendocino		*								*		*	
Merced	*		*		9		*		3				
Modoc													
Monterey	*	12	2	*						*			
Napa	*	*	*	*	*		*		*	4	*	4	
Nevada		3	*	*					*	*	*		
Orange			4			7		10					38
Placer	*	*		3	*		*		6	7	39		
Riverside	3	*	7	*		16	11	14	*	*		*	
Sacramento	6		*	5			5	*	*	18	8	*	
San Benito	*		6	*					*	*	*	3	
San Bernardino		4	4	*		13	7	31	5				2
San Diego	*	*	*			10	5	*	*				
San Joaquin	12		3	25	*		4		8	4	*	*	
San Luis Obispo	*	*	*										
Santa Barbara		*	*	2		*	2						10
Santa Clara	*	*	21	26	*				5	9	18	55	
Santa Cruz		51	3	2					*			*	
Shasta	*	*					*		*	*		*	
Siskiyou		*											
Solano	6		3	10					3	6	16	4	
Sonoma	*	16	*	9	*		5		*	6	*	12	
Stanislaus	6		*	*	5			*	3	*			
Sutter	9			*	8		*		2	*	*	*	
Tehama	*	*	*		*		11	*	*	2	*	*	
Tulare	*		*		6	5	6	13	9		2	4	
Ventura			6			15		2					20
Yolo	11		5		5		3		2	9	4	2	
Yuba	*				2		3	*	*	*	*		

*Less than 2 per cent of State's normal crop grown in county.

Grape Report.

County	Raisin (per cent)	Table (per cent)	Wine (per cent)	County	Raisin (per cent)	Table (per cent)	Wine (per cent)
Alameda	#	#	25	Orange	—	100	—
Butte	70	70	#	Placer	----	35	----
Colusa	75	75	#	Riverside	#	90	90
Contra Costa	#	80	80	Sacramento	25	25	25
El Dorado	#	40	40	San Bernardino	100	100	100
Fresno	100	100	100	San Diego	100	100	100
Glenn	80	80	#	San Joaquin	#	50	70
Humboldt	#	#	#	San Luis Obispo	#	#	#
Inyo	----	75	----	Santa Barbara	#	#	#
Kern	100	100	100	Santa Clara	#	#	—
Kings	100	100	#	Santa Cruz	#	50	50
Lake	#	#	25	Shasta	75	75	75
Los Angeles	100	100	100	Siskiyou	#	15	#
Madera	100	80	110	Sonoma	----	----	70
Marin	#	100	100	Stanislaus	125	125	125
Mendocino	----	----	75	Sutter	90	100	100
Merced	100	100	100	Tehama	#	#	#
Modoc	#	#	#	Tulare	100	100	100
Monterey	#	50	50	Ventura	#	—	—
Napa	----	----	35	Yolo	80	80	80
Nevada	#	90	90	Yuba	100	100	100

Figures in table indicate condition of crop in per cent, on the basis of 100 as normal.
— Horticultural commissioner has insufficient information for a report.
Not grown commercially.

THE MONTHLY BULLETIN

CALIFORNIA STATE COMMISSION OF HORTICULTURE.

DEVOTED TO HORTICULTURE IN ITS BROADEST SENSE, WITH SPECIAL REFERENCE TO PLANT DISEASES, INSECT PESTS, AND THEIR CONTROL.

Sent free to all citizens of the State of California. Offered in exchange for bulletins of the Federal Government and experiment stations, entomological and mycological journals, agricultural and horticultural papers, botanical and other publications of a similar nature.

Entered as second class matter December 29, 1911, at the post office at Sacramento, California, under the act of June 6, 1900.

Weeds Along the State Highway.—The problem of eradicating the noxious weeds along the public roads has been a difficult one for a good many years. It is not right to order a farmer to eradicate noxious pests from his land when the neighboring roads are allowed to go uncleaned. The county commissioners have realized this and have done their best to force the county supervisors to do their duty. They have continued, and I believe rightly, to enforce the law on the farmer and orchardist believing that half a job is better than no job at all.

With the advent of the state highways the question of weed eradication was again brought up. The Highway Commission has shown a great interest and a willingness to co-operate in every way with the clean-up work. During the summer they have kept men busy cutting the noxious growth and burning trash. They have recently taken up the problem of complete eradication of certain of the most noxious weeds, such as morning glory and the thistles. The first experiment along this line is now being tried in Orange County, and crude oil or petroleum is being used. We will watch the results with a great deal of interest, as any means of eradication which will be efficient and at the same time economical, will be of value to the whole state.

We do not believe that all weeds along the roads should be killed. In the spring they are good to look at and also their roots serve to hold the soil of embankments in place. We believe, however, that all weeds should be cut during the summer to remove their unsightly appearance, and especially that all noxious weeds should be absolutely eradicated. We wish to express our thanks to the State Highway Commission for the readiness they have shown to co-operate in this work.—O. W. NEWMAN.

Planting Potatoes on New Land.—In the Journal of Agricultural Research, United States Department of Agriculture, Vol. VI, No. 15, issued July 10, 1916, there is an article by O. A. Pratt, Assistant Pathologist of the Bureau of Plant Industry, on experiments with clean seed potatoes on new land in South Dakota. The writer of the article states that it has been generally assumed by plant pathologists that if disease-free potatoes were planted on new land the resulting potatoes would be free from disease. Pathologists and potato growers believed that in these new lands just reclaimed from the desert there would lie a wonderful opportunity for the production of disease-free potatoes. It is found, after an investigation lasting one year, that planting clean potatoes on new land did not guarantee a disease-free production, and second, that a smaller percentage of disease might appear in the production when clean seed was planted on alfalfa or grain land, than when similar seed was planted on virgin or raw desert land.

In these experiments all precautions were taken against planting diseased seed, and after cutting, the tubers were disinfected for one and one-half hours in a solution of mercury bichloride.—E. J. V.

Marin County Appoints a Horticultural Commissioner.—The Supervisors of Marin County have appointed Mr. Thomas P. Redmayne as Horticultural Commissioner. Like forty-four other counties of California, Marin County has awakened to the advantages to be derived from such an officer. We wonder when the growers of Solano County, one of the most important fruit districts in California, will rub the sleep from their eyes, and demand the appointment of a horticultural officer.—E. J. V.

Statistics on the Cost of Bringing Orchards Into Bearing.—There is a decided demand for statistics on the cost of bringing orchards into bearing. Such figures are extremely rare, and their value is unquestioned, particularly to the prospective planter with a very limited capital and very limited knowledge. If one who is contemplating the planting of an orchard could know just what it would cost, many a failure would be averted. If any of our readers have such figures, or know of any one who has just started an orchard and who is keeping a set of books, he will certainly confer a great favor on the editor by informing him of that fact.—E. J. V.

Community Buying.—In these days of organization of the farmers into units which are known in certain counties in California as "Farm Bureaus," we can see how efficiency on the farm and in the orchard may be increased by the community purchase of farming implements such as tractors and trucks. Taken individually, the growers can not afford to purchase a truck or tractor for the small amount of plowing, cultivating or hauling they would have to do, but if they can secure for comparatively small outlay, the use of a tractor or truck for a few days each month, a considerable amount of time and money would be saved.—E. J. V.

Certified Seed Potatoes.—We are receiving numerous requests from potato growers who are contemplating growing certified seed under the Certified Seed Potato Act, for an inspection to be made of their fields, and the Commissioner of Horticulture has arranged for this inspection to be done by Mr. W. V. Shear, Secretary of the West

Coast Potato Association, and who formerly was an expert with the United States Department of Agriculture. Details as to the cost of inspection can be secured by writing to the State Commission of Horticulture, Sacramento. The first inspection must be made at blooming time in order to determine whether the fields are free from mixture of varieties. So in many cases an immediate request for the inspector will be necessary.—E. J. V.

Forty-ninth State Fruit Growers' Convention.—The next State Fruit Growers' Convention—the forty-ninth—will be held at Napa, California, some time in November, the exact date to be announced later. Arrangements are being made for an industrial exhibit of farm tractors and farm machinery. Every fruit grower in the state should be making arrangements to attend this convention. It will be without doubt the best ever held in the state. Suggestions as to subjects to be discussed at the convention will be heartily welcomed by us, and should be in our hands before the first of October. The program will be published in the Bulletin in some later issue.

The Napa Valley is one of the most beautiful fruit growing districts, and a tour of this valley coupled with the convention will make the trip doubly profitable.—E. J. V.

Apple Standardization.—We are again printing herein the act relating to the standardization of apples. The Watsonville Apple Distributors are again contemplating packing apples under this act, as last year they had such remarkable success from so doing. The growers netted approximately ten cents a box over their competitors who did not pack under this law. Approximately 600,000 boxes were inspected by the inspectors provided by the Commission of Horticulture, and stamped with the state seal.—E. J. V.

Assembly Bill No. 243.

CHAPTER 712.

An act to establish a standard for the packing and marketing of apples, fixing penalties for the violation of its provisions, and providing for its enforcement and making an appropriation to carry into effect the provisions hereof.

[Approved June 10, 1915.]

The people of the State of California do enact as follows:

SECTION 1. This act shall be known, and for any and all purposes may be referred to, as "The standard apple act of 1915."

SEC. 2. The provisions of this act shall be applicable to all apples packed, shipped, delivered for shipment, offered for sale or sold in the State of California, in any container upon which or the label of which the word "standard" is used as the brand or label or any part thereof, or as qualifying the pack, container, or the contents of the container, and to such container.

SEC. 3. No apples shall be packed, shipped, delivered for shipment, offered for sale or sold, in the State of California, in any container upon which or the label of which the word "standard' is used as the

brand or label or any part thereof, or as qualifying the pack, container or the contents of the container, unless such apples and such container shall comply with all of the requirements of this act.

SEC. 4. The following standards for apple boxes and for the packing, labeling and branding of apple boxes to which this act is made applicable, are hereby established:

(*a*) The standard container shall be a box of the following dimensions, inside measurements, when measured without distention of its parts:

Depth of end, ten and one-half inches; width of end eleven and one-half inches; length of box, eighteen inches; and having a cubical content of as nearly as possible, two thousand one hundred seventy-three and one-half cubic inches; *provided,* that a smaller box may be used if plainly marked, on one side and on the labeled or branded end with the words "short box."

(*b*) No statement, design, or device, appearing upon any box within which apples are contained, or upon the brand, or lining thereof, or upon the wrapper of any apple, or upon any sign, or placard used in connection therewith, and having reference to or regarding the box or the apples contained therein, shall be false or misleading in any particular.

(*c*) Every box, within which apples are contained, shall bear upon the outside of one or both ends thereof, in plain words or figures, and in the English language, the following statement: the number of apples in the box; the style of pack used; the variety of the apples contained, unless the variety be unknown to the packer, in which case the variety shall be stated as "unknown"; the name and business address of the person, firm, company, organization or corporation, who first packed or caused the same to be packed, and, if re-packed, the name and address of the person, firm, company, organization, or corporation who re-packed, or caused the same to be re-packed; the name of the locality where said apples were grown; the date when such apples were first packed; if the apples have been re-packed, the date of re-packing; and the stamp hereinafter provided for, canceled as required by the state commissioner of horticulture of California. A variation of three apples more, or less, than the number stated, shall be allowed.

(*d*) The apples contained within each box shall be well grown specimens of one variety, hand picked, well colored for the variety, reasonably uniform in size, properly matured, well packed, and practically free from dirt; and shall be free from insect pests, diseases, rot, insect bites, bruises and other defects, except such bruises and defects as are necessarily caused in the operation of packing; *provided, however,* that a variation from the standard as to insect pests, diseases, rot, insect bites, bruises, and other defects, shall be allowed, not to exceed ten per cent total such defects, nor to exceed three per cent of any one such defect.

SEC. 5. The state commissioner of horticulture of California shall be charged with the enforcement of the provisions of this act, and for that purpose shall have power:

(*a*) To enter and to inspect every place within the State of California where apples are packed, shipped, delivered for shipment, offered for sale or sold, and to inspect all apples and apple boxes found in any such place.

(*b*) To design, and cause to be printed or lithographed, suitable uniform stamps to be used on apple boxes, as required by section 4 of this act, to sell the same as hereinafter provided, and to prescribe the method of canceling the same.

(*c*) To appoint, superintend, control, and discharge, such inspectors, in accordance with the provisions of the civil service law of the state, for the special purpose of enforcing the provisions of this act, as in his discretion may be deemed to be necessary, and in conjunction with the board of control, to fix their compensation, provided that no inspector shall be paid more than five dollars per day.

(*d*) Personally, or through any deputy or any such inspector, to seize and retain possession of, any apples or apple boxes packed, shipped, delivered for shipment, offered for sale or sold, in violation of any of the provisions of this act.

(*e*) In the name of the people of the State of California to cause to be instituted and to prosecute, in the superior court of any county or city and county of the State of California, in which apples packed, shipped, delivered for shipment, offered for sale or sold, in violation of any of the provisions of this act, may be found, an action or actions for the condemnation of apples as provided in section 11, of this act.

SEC. 6. The stamps designed and provided by the state commissioner of horticulture of California, as provided by section 5 of this act, by him shall be placed on sale and sold to any person who may apply therefor, at the price of one-half cent each. All moneys received by him from the sale of such stamps shall be paid over to the treasurer of the State of California, who shall deposit the same to the credit of a fund to be used exclusively for the payment of the expenses of enforcing the provisions of this act, and to be paid out only upon claims approved by the state commissioner of horticulture of California and by the board of control.

SEC. 7. One such stamp, canceled as required by the state commissioner of horticulture, shall be attached by the packer to the labeled or branded end of every box of apples to which this act is made applicable; and no box to which such stamp is attached shall be used as the container of any apples, other than those originally packed therein, until such stamp has been removed therefrom; *provided*, that where a single lot of not to exceed one carload of six hundred forty boxes of apples, the containers of which bear such stamps, are re-packed without the addition of new stock, the same boxes may be used without removing the stamps.

SEC. 8. The inspectors appointed by the state commissioner of horticulture of California, as in section 5 hereof provided, shall be citizens of the United States, and of the State of California, not less than twenty-one years of age, shall be skilled in the inspection of apples, and have a thorough knowledge of insect pests and diseases commonly preying upon such fruit; they shall have power to enter and to inspect every place within the State of California where apples are packed, shipped, delivered for shipment, offered for sale or sold, and to inspect all apples and apple boxes found in any such place; and shall perform such duties as may be prescribed by the state commissioner of horticulture of California, or by law.

The said commissioner shall assign such inspectors to such territory, within the state, as he may see fit; *provided,* that when the stamps purchased for any year by packers in any town, city or district, shall yield a sum of money sufficient to pay the expense thereof, such commissioner shall assign one inspector or more for special duty in such town, city or district, during the packing season of that year.

SEC. 9. No person, firm, company, organization or corporation, shall refuse to permit the state commissioner of horticulture of California, or any of his duly appointed deputies, or any inspector duly appointed by said commissioner under the provisions of this act, to enter or to inspect any place within the State of California where apples are packed, shipped, delivered for shipment, offered for sale or sold, or to inspect any apples or apple boxes found there.

SEC. 10. Any person, firm, company, organization or corporation, who shall violate any of the provisions of this act shall be punishable by a fine of not less than fifty dollars nor more than five hundred dollars, or by imprisonment in the county jail for a period of not more than six months, or by both such fine and imprisonment.

SEC. 11. Any apples packed, shipped, delivered for shipment, offered for sale or sold, in violation of any of the provisions of this act, and the boxes within which they are contained, shall be deemed to be a public nuisance, may be seized and by order of the superior court of the county or city and county within which the same may be found, shall be condemned and destroyed or released upon such conditions as the court in its discretion may impose to insure that they will not be packed, shipped, delivered for shipment, offered for sale or sold in violation of any of the provisions of this act.

SEC. 12. No person, firm, company, organization or corporation, shall be convicted of a violation of any provision of this act, if he shall establish a guaranty, signed by the person, firm, company, organization, or corporation, residing or lawfully engaged in business in the State of California, by or for whom the apples in question were originally packed, or re-packed, to the effect that the apples, box, brand and label in question comply in all respects with the provisions of this act, and, in addition, shall establish that the same are in substantially the same condition, in every respect, as they were when they were delivered out of the possession of such packer, and that the accused was not aware that such apples, box, brand or label, were or was in any respect in violation of any provision of this act. The signature to such guaranty may be printed, when done by the authority of the signer.

To afford protection, such guaranty, in form and substance, must be substantially as follows:

"The undersigned guarantees that (this box of apples or the boxes of apples mentioned in this, or the attached invoice, or all boxes of apples packed or re-packed by the undersigned, and bearing the word 'standard,' as the case may be) comply, in all respects with the standard apple act of 1915. (Signature of the packer, with statement as to whether packer is firm, company, organization or corporation and business address.)"

Where the guaranty is used on each separate box, it may consist of the legend, "guaranteed by the packer, under the standard apple act of 1915," printed, stamped or written on the labeled or branded end of the box.

SEC. 13. It shall be the duty of the district attorney of the county, or city and county, in which any violation of this act may occur, to prosecute the person, firm, company, organization or corporation accused of such violation, and also, at the request of the state commissioner of horticulture, to institute and prosecute such actions for condemnation as may be authorized under the provisions of this act.

SEC. 14. No act which is made unlawful by any provision of an act of the legislature of the State of California, entitled, "An act for preventing the manufacture, sale or transportation of adulterated, mislabeled or misbranded foods and liquors and regulating the traffic therein, providing penalties, establishing a state laboratory for foods, liquors and drugs and making an appropriation therefor," approved March 11, 1907, or any amendment thereto, shall be deemed lawful by reason of any provision of this act; nor shall this act be construed in any respect to limit the powers of the state board of health.

SEC. 15. The sum of five thousand dollars ($5,000.00) is hereby appropriated out of any money in the state treasury, not otherwise appropriated, for the payment of the cost of printing, stationery, stamps, clerical assistance, traveling expenses, and salaries of inspectors, incurred by the state commissioner of horticulture in the enforcement of this act during the fiscal year commencing July 1, 1915. The state controller is hereby authorized to draw his warrants for the sum herein appropriated in favor of said commissioner and the state treasurer is hereby directed to pay the same.

Beet Leaf-hopper Parasites.—The state insectary has just received from the Hawaiian Islands, through the kindness of Mr. O. H. Swezey of the Sugar Planters' Experiment Station, a remarkable colony of parasites for use against the sugar beet leaf-hopper. The parasite, technically known as *Ootetrastichus beatus*, is a very important enemy of the leaf-hopper of the sugar-cane in the Islands, and has been of immeasurable value to the sugar industry there. While the parasite has never been recorded from the beet leaf-hopper, it breeds upon other Jassids, and it is not too much to hope that the beet leaf-hopper will be attacked. In 1914 it was estimated that one sugar company alone in California lost nearly a million dollars through the ravages of this pest. Since no remedy has ever been discovered, any possibility of assistance to be had through the introduction of parasites should be taken advantage of.—H. S. S.

Publications of the Department of Agriculture.—To secure the monthly list of publications of the United States Department of Agriculture, write to the Chief of the Division of Publications, United States Department of Agriculture, Washington, D. C. The farmers' bulletins may be obtained free upon application to the Editor of the Division of Publications. The following farmers' bulletins were issued during June:

FARMERS' BULLETINS—FOR FREE DISTRIBUTION.

No price is quoted for Farmers' Bulletins for the reason that the department's supply of the current numbers is ordinarily sufficient to make it possible to send them free to all applicants.

Measuring and Marketing Woodlot Products. By Wilbur R. Mattoon and William B. Barrows, Forest Examiners. Pp. 48, figs. 13. Contribution from the Forest Service. June 29, 1916. (Farmers' Bulletin 715.)

Suitable for general distribution, and will be helpful to farmers in selling woodlot products.

Management of Sandy-Land Farms in Northern Indiana and Southern Michigan. By J. A. Drake, Agriculturist, Office of Farm Management. Pp. 28, figs. 3. Contribution from the Office of Farm Management, Office of the Secretary. June 9, 1916. (Farmers' Bulletin 716.)

This bulletin, while applying particularly to areas where sandy lands occur in southern Michigan, northern Indiana and a part of northwestern Ohio, should prove of interest to farmers occupying sandy lands in other portions of the country not too far north to permit of maturing the crops recommended.

Prevention of Losses of Live Stock from Plant Poisoning. By C. Dwight Marsh, Physiologist in Poisonous-Plant Investigations, Pathological Division. Pp. 11. Contribution from the Bureau of Animal Industry. June 2, 1916. (Farmers' Bulletin 720.)

Of especial interest to western ranchers and stock raisers. Supersedes Farmers' Bulletin 536 on Stock Poisoning Due to Scarcity of Food.

The Feeding of Grain Sorghums to Live Stock. By George A. Scott, Scientific Assistant, Animal Husbandry Division. Pp. 15, figs. 5. Contribution from the Bureau of Animal Industry. June 7, 1916. (Farmers' Bulletin 724.)

This bulletin will be of interest to cattle feeders and farmers generally in the semiarid regions where grain sorghums do better than corn.

Natal Grass: A Southern Perennial Hay Crop. By S. M. Tracy, Agronomist, Forage Crop Investigations. Pp. 16, figs. 4. Contribution from the Bureau of Plant Industry. June 8, 1916. (Farmers' Bulletin 726.)

Suitable for distribution in South Atlantic and Gulf States and southwestern California and New Mexico.

Growing Fruit for Home Use in the Great Plains Area. By H. P. Gould, Pomologist in Charge of Fruit-Production Investigations, Office of Horticultural and Pomological Investigations, and Oliver J. Grace, Supterintendent, Akron Field Station, Dry-Land Agriculture Investigations. Pp. 40, figs. 25. Contribution from the Bureau of Plant Industry. June 30, 1916. (Farmers' Bulletin 727.)

Is intended especially for those in the Great Plains area who are interested in growing fruit for home use, but some parts of it, especially the discussion about pruning and shaping trees, are of general interest to people living in other sections of the country.

Dewberry Culture. By George M. Darrow, Scientific Assistant, Office of Horticultural and Pomological Investigations. Pp. 19, figs. 12. Contribution from the Bureau of Plant Industry. June 12, 1916. (Farmers' Bulletin 728.)

For general distribution.

Button Clover. By Roland McKee, Assistant Agrostologist, Forage-Crop Investigations. Pp. 11, figs. 3. Contribution from the Bureau of Plant Industry. June 2, 1916. (Farmers' Bulletin 730.)

Suitable for distribution in the South Atlantic and Gulf States and the Pacific Coast States.

The Corn and Cotton Wireworm in Its Relation to Cereal and Forage Crops, with Control Measures. By Edmund H. Gibson, Scientific Assistant, Cereal and Forage Insect Investigations. Pp. 8, figs. 3. Contribution from the Bureau of Entomology. June 9, 1916. (Farmers' Bulletin 733.)

The object of this bulletin is to set forth in a popular form what is known of the habits of the destructive corn and cotton wireworm, in order that farmers and planters may more effectively carry out control measures and be able better to handle infested areas that the injury may be reduced to a minimum.

Flytraps and Their Operation. By F. C. Bishopp, Entomological Assistant. Pp. 14, fig. 7. Contribution from the Bureau of Entomology. June 10, 1916. (Farmers' Bulletin 734.)

Is intended to give directions for the use of a supplementary means of controlling flies; it is adapted to all parts of the United States.

The Red Spider on Cotton and How to Control It. By E. A. McGregor, Entomological Assistant, Southern Field Crop Insect Investigations. Pp. 12, figs. 10. Contribution from the Bureau of Entomology. June 12, 1916. (Farmers' Bulletin 735.)

For distribution in cotton growing states.

The Clover Leafhopper and Its Control in the Central States. By Edmund H. Gibson, Scientific Assistant, Cereal and Forage Insect Investigations. Pp. 8, figs. 5. Contribution from the Bureau of Entomology. June 26, 1916. (Farmers' Bulletin 737.)

It is the purpose of this bulletin to set forth such facts as will familiarize the farmer with the various stages in the development of the clover leafhopper, its habits, and mode of attack, together with detailed information as to the control of outbreaks in alfalfa and clover fields.

Cereal Crops in the Panhandle of Texas. By John F. Ross, Farm Superintendent, Office of Cereal Investigations. Pp. 16, figs. 5. Contribution from the Bureau of Plant Industry. June 15, 1916. (Farmers' Bulletin 738.)

Of interest to farmers and prospective settlers in the Texas Panhandle country.

Cutworms and Their Control in Corn and Other Cereal Crops. By W. R. Walton and J. J. Davis, Entomological Assistants, Cereal and Forage Insect Investigations. Pp. 4, fig. 1. Contribution from the Bureau of Entomology. June 1, 1916. (Farmers' Bulletin 739.)

Suitable for general distribution.

The White-Pine Blister Rust. By Perley Spaulding, Pathologist, Office of Investigations in Forest Pathology. Pp. 15, pl. 1, fig. 4. Contribution from the Bureau of Plant Industry. June 9, 1916. (Farmers' Bulletin 742.)

Suitable for general distribution.

Russell D. Stephens

RUSSELL D. STEPHENS.

In the death of Russell D. Stephens of Sacramento, the California fruit industry has suffered an irreparable loss. He was one of the most prominent figures in the State Fruit Growers' conventions, being for a number of years chairman of the Transportation Committee. He was also chairman of the Executive Committee of the State Board of Horticulture before the law relating to the State Horticultural Commissioner was passed.

Mr. Stephens was born in April, 1837, at Canton, Illinois, and came to California in 1849. His parents located at Mayhew, California, in 1850. He was concerned principally with the grape industry, shipping very largely Tokay grapes, which developed for him a wide reputation in the eastern markets.

Death came on July 15th, at his home in Sacramento. He is survived by a widow, a daughter and a son.

A SATISFACTORY METHOD OF REARING MEALY BUGS FOR USE IN PARASITE WORK.*

By E. J. BRANIGAN.

Owing to the scarcity of room at the state insectary for growing plants upon which to raise mealy bugs for parasite use, and to the relative slowness with which they multiplied on these plants alone, experiments were carried out in rearing them on potato sprouts. Many other host plants have been tried out, but all have been discarded for this method which has proved to be most excellent.

FIG. 98.—This cage contains twenty trays of mealy bug-infested potatoes. (Original.)

*The mealy bugs affecting citrus and grapes (*Pseudococcus citri*, *P. bakeri*, *P. citrophilus* and others) are among the most serious of California pests. Since they are very difficult to control by artificial means, such as spraying and fumigation, we have devoted and are devoting a considerable part of our time to the securing of new natural enemies as an aid to their repression. For the propagation of the new enemies introduced from foreign countries, large quantities of mealy bugs are needed. Mr. Branigan has been very successful in producing these insects in large numbers by the method outlined here, and I have asked him to prepare this article, feeling sure that it will be of much benefit to others engaged in similar work. We have already made excellent use of it in transporting enemies of mealy bugs from Japan to California.—HARRY S. SMITH.

Common potatoes were spread on the floor of the greenhouse, under the benches, on April 1st. On April 9th they commenced to sprout. They were then placed in box trays 3 inches deep and of a standard size so as to fit the cages in which they were to be used. The cages hold four trays, one above the other when filled, and are operated as follows: One tray of infested potato sprouts is placed in the cage, together with the ladybirds or parasites. When the supply of mealy bugs in this tray is exhausted it will of course contain a large number of immature forms of ladybirds or parasites as the case may be. This tray is then shifted to the bottom of the cage and a fresh tray filled with mealy bug-infested potato sprouts placed immediately above it. This gives an opportunity for the ladybird larvæ to crawl up where there is plenty of food available. This procedure is continued until all four trays are in the cage.

The bottom of the tray is filled with sand about one inch deep and the potatoes fitted in closely and moistened. The trays are then placed in a large cupboard-like cage, holding about 20 trays. This cage is darkened by means of a heavy canvas curtain and kept in a

FIG. 99.—Showing potato sprouts heavily infested with mealy bugs. (Original.)

warm greenhouse. (See Fig. 98.) The sprouts grow very rapidly and are stocked by placing in each tray a number of lemons or potato sprouts infested with young mealy bugs. In this particular instance the sprouts were 10 to 12 inches long by May 14, and very heavily infested with young mealy bugs. (See Fig. 99.) The infested sprouts may be cut off if desired for feed, since they will keep fresh for 10 or 12 days

even in a dry cage. The sprouts remaining on the potatoes will branch in a few days and grow very rapidly, with the mealy bug infestation increasing. In this way the potatoes will produce three or four times as many sprouts as they do without pruning.

The propagation of mealy bugs by this method will no doubt be of great value in the transportation of their enemies across the continent, as it is very difficult to get infested plants to hold up long enough for such a voyage. In the trays, after sprouting, the potatoes will form a new crop of young tubers in the sand and in time these too will sprout, keeping the food supply continuous for a long period.

A SUBLABORATORY OF THE INSECTARY IN THE SOUTH.

By Harry S. Smith.

The culture of subtropical fruits in this state, as is well known, had its origin in the region south of the Tehachapi Mountains. The major portion of these fruits is still grown in that part of the state, although there is a great extension of the industry to the north at the present time. As a general proposition, work with parasitic and predaceous insects is of promise only in connection with pests introduced from foreign countries. It happens that most of the serious pests of subtropical fruits in this state are introduced forms, probably for the reason that no plants closely related to citrus or olives are indigenous to California, so that few of our native insects have adapted themselves to any serious extent to these exotic fruits. By reason of these facts a large part of the activities of the insectary have been and will continue to be with the insect pests of subtropical fruits. There is no denying the fact that the work of the insectary has been greatly handicapped in the past by its location in Sacramento, since for financial reasons much traveling back and forth has been impossible, and the sending of delicate parasites by mail has never been satisfactory. Furthermore, the proper colonization of parasites in the orchard is of first importance, and it has not in the past been possible to do this, since it meant depending upon persons who, though willing and anxious to do all in their power to assist in the work, had not the intimate knowledge of the parasites which is a requisite to their proper handling. It is also of utmost importance to follow closely the progress of the new introductions in the orchard, and this has not been possible under conditions as they have been. For these reasons we have established during the past month a sublaboratory of the insectary, located for the present at Pasadena, and in charge of Mr. E. J. Branigan. Our entire breeding stock of *Paraleptomastix abnormis*, the promising new mealy bug parasite from Sicily, has been transferred to Pasadena, and Mr. Branigan will occupy himself largely for the present with the colonization of this parasite and other new ones which we are receiving from time to time from Mr. Clausen, who is now in the Orient collecting beneficial insects. All new insects will, of course, as heretofore, come first to Sacramento where they can be studied in insect-proof rooms and any dangerous forms eliminated. After their life histories have been thoroughly worked out, any promising species of value to subtropical fruits will be forwarded to the sublaboratory for breeding and colonization. This arrangement will also enable us to keep much closer track of suitable localities for parasite colonies.

It is greatly to be hoped that this sublaboratory can be continued indefinitely, either through still closer co-operation with the Bureau of Entomology of the United States Department of Agriculture, or through a slightly increased appropriation by the next legislature.

QUARANTINE DIVISION.

REPORT FOR THE MONTH OF JUNE, 1916.

By Frederick Maskew.

SAN FRANCISCO STATION.

Steamship and baggage inspection:

Ships inspected	69
Passengers arriving from fruit fly ports	2,901

Horticultural imports:

	Parcels
Passed as free from pests	67,835
Fumigated	2,750
Refused admittance	66
Contraband destroyed	29
Total parcels horticultural imports for the month	70,680

Pests Intercepted.

From China:

Chrysomphalus rossi on boxwood.

From Central America:

Aspidiotus cyanophylli, Selenaspidus articulatus, and *Pseudococcus* sp. on bananas.

From Hawaii:

Diaspis bromeliæ and *Pseudococcus bromeliæ* on pineapples.
Coccus longulus on betel leaves.
Chrysomphalus aonidum on green cocoanuts
Lepidosaphes sp., *Parlatoria* sp., *Pseudococcus* sp., *Howardi biclavis, Pseudococcus longispinus, Chrysomphalus* sp., *Orthezia* sp., *Eucalymnatus perforatus, Coccus longulus, Hemichionaspis minor* and *Thrips* sp. on unknown plants.

From Japan:

Larvæ of weevil in sweet potatoes.
Lepidosaphes beckii, Pseudaonidia trilobitiformis and *Parlatoria pergandii* on lemons.
Coccid on bamboo.
Fungus on lemons.
Lepidopterous larvæ in dried persimmons.
Larvæ of borer in roots of berry.
Pseudococcus sp., *Phytomyza* sp., *Thrips* sp. and Tipulid larvæ in soil on iris plants.

From Mexico:

Lepidosaphes beckii on limes.
Lepidopterous larvæ in corn on cob.

From Tahiti:

Morganella maskelli and *Lepidosaphes beckii* on oranges.

LOS ANGELES STATION.

Ships inspected	25

Horticultural imports:

	Parcels
Passed as free from pests	33,119
Fumigated	8
Refused admittance	4
Contraband destroyed	3
Total parcels horticultural imports for the month	33,134

Pests Intercepted.

From Central America:

Aspidiotus cyanophylli and *Pseudococcus* sp. on bananas.

From Pennsylvania:

Cerataphis lataniæ on Kentia palms.

SAN DIEGO STATION.

Steamship and baggage inspection:

Ships inspected	26
Fish boats inspected	26
Passengers arriving from fruit fly ports	138

Horticultural imports:

	Parcels
Passed as free from pests	2,145¾
Fumigated	5
Refused admittance	8¼
Contraband destroyed	9
Total parcels horticultural imports for the month	2,168

Pests Intercepted.

From Florida:

Lepidosaphes sp. and Melanose on grapefruit.
Pseudococcus sp. on pineapples.

From Mexico:

Trypeta ludens larvæ in mangoes.

From New Jersey:

Pseudococcus sp. and *Coccus hesperidum* on *Cocoloba pubescens.*

From Pennsylvania:

Dialeurodes citri on gardenia plants
Hemichionaspis aspidistræ and *Saissetia hemisphærica* on ferns.

EUREKA STATION.

Ships inspected	6

Horticultural imports:

	Parcels
Passed as free from pests	19
Fumigated	
Contraband	
Total parcels horticultural imports for the month	19

Pests Intercepted.

From Victoria, B. C.:

Chionaspis pinifoliæ on *Baga Hookeriana.*

SANTA BARBARA STATION.

(No report.)

COUNTIES HAVING HORTICULTURAL COMMISSIONERS, WITH THE RESPECTIVE CITIES IN WHICH THE COMMISSIONERS RESIDE.

County	City
Alameda	Oakland
Butte	Oroville
Colusa	Colusa
Contra Costa	Martinez
El Dorado	Placerville
Fresno	Fresno
Glenn	Willows
Humboldt	Eureka
Imperial	El Centro
Inyo	Bishop
Kern	Bakersfield
Kings	Hanford
Lake	Kelseyville
Lassen	Susanville
Los Angeles	Los Angeles
Madera	Madera
Mendocino	Ukiah
Merced	Merced
Modoc	Alturas
Monterey	Aromas
Napa	Napa
Nevada	Grass Valley

County	City
Orange	Santa Ana
Placer	Bowman
Riverside	Riverside
Sacramento	Sacramento
San Benito	Hollister
San Bernardino	San Bernardino
San Diego	San Diego
San Joaquin	Stockton
San Mateo	Redwood City
Santa Barbara	Santa Barbara
Santa Clara	San Jose
Santa Cruz	Watsonville
Shasta	Anderson
Siskiyou	Yreka
Sonoma	Santa Rosa
Stanislaus	Modesto
Sutter	Yuba City
Tehama	Red Bluff
Tulare	Visalia
Ventura	Ventura
Yolo	Woodland
Yuba	Marysville

THE MONTHLY BULLETIN.

CALIFORNIA STATE COMMISSION OF HORTICULTURE

Vol. V. September, 1916. No. 9

HOW THE QUARANTINE DIVISION PROTECTS THE COTTON PRODUCER.

By Frederick Maskew.

Probably no one crop grown in the United States is more continuously in the mind's eye of the general public than that of cotton and possibly no one crop so particularly concerns the ultimate necessities of our 100,000,000 population as does that of cotton in some of its manufactured stages. No matter what our individual predilections

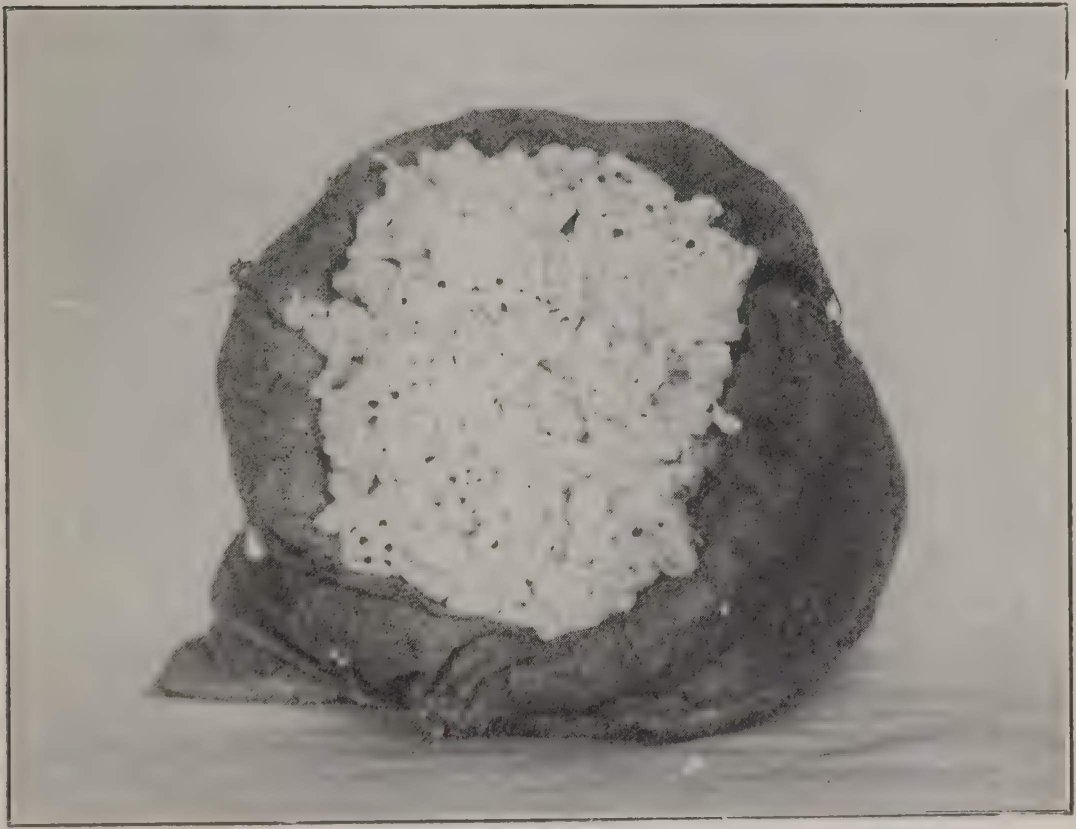


Fig. 100.—Cotton seed in raw cotton found in the baggage of passengers. (Photo by L. A. Whitney.)

may be as to meat, bread, fruit or sugar, convention compels us all to wear stockings and use handkerchiefs. To protect the primal domestic source of these and numerous other daily necessities, many regulations have been promulgated and put into practice, and the purpose of this article is to give publicity to those now in force in our state to prevent the introduction and establishment of the Boll Weevil and the Pink Boll Worm into the cotton fields of California. The extent to which

these regulations are carried—under legal sanction—is but little realized by the general public, or even by those most vitally concerned, the actual growers of cotton.

It is generally recognized that the principal source of introduction from one widely separated country to another of these major insect pests of growing cotton is through the medium of cotton seed. Foreign countries, particularly Egypt, have demonstrated the truth of this theory, and, profiting by their unfortunate experience, the United States Department of Agriculture, in an effort to keep out the Pink Boll Worm, *Gelechia gossypiella*, prohibits by Notice of Quarantine, the importation into the United States of cotton seed and cotton seed hulls, and the activities of the inspectors in executing the provisions of this regulation prevents the entrance of the same.

Fig. 100 is an example of some of these activities and illustrates cotton found in the baggage of passengers arriving at San Francisco from foreign ports. Cotton seed—as may be plainly seen—was associated with this cotton and as a consequence of violating regulations the whole was confiscated and burnt. The cotton shown in the photograph was collected in small amounts from the different pieces of baggage arriving in one vessel, and is typical of similar findings.

The importation of cotton into the United States for any purpose whatsoever is controlled by stringent regulations issued by the United States Department of Agriculture, and these regulations are at all times enforced by the United States Customs and the horticultural inspectors. Raw or unmanufactured cotton lint, either baled or unbaled, including all cotton which has not been woven or spun or otherwise manufactured, such as all forms of cotton waste, including thread waste, card strips, willowed fly, willowed picker, picker or blowings, and chum and cotton waste in any other form arriving from countries that do not maintain an official system of cotton inspection must be fumigated before being distributed from port of entry. This procedure is made necessary by the presence of cotton seed in such material. Special ports of entry have been assigned for this purpose and all foreign cotton seeking an entrance into the United States is admitted only through such ports. San Francisco is the only port open to imports of cotton on the Pacific Coast of continental United States.

Fig. 101 illustrates the apparatus used for fumigating foreign cotton seeking an entrance into the United States through the port of San Francisco. This consists of a boiler plate cylinder 29 feet long and 8 feet in diameter, reinforced with channel iron on the interior side and so constructed that it will support a 25-inch vacuum for not less than 15 minutes; provided with two vacuum gauges to register pressure, and steam pipes for raising the temperature if necessary. In the center of the picture can be seen the acid proof generator in which are brought together the cyanide, acid and water used for fumigation and where the hydrocyanic-acid gas is generated before being admitted into the chamber. On the extreme left is the pump run by electric power which exhausts the air and creates the vacuum.

Fig. 102 shows the method of loading the chamber with cotton preparatory to fumigation. A rail track runs the entire length of the chamber and small cars fitted to use these tracks are loaded outside. Fifteen bales of cotton is an average load for a car and the chamber

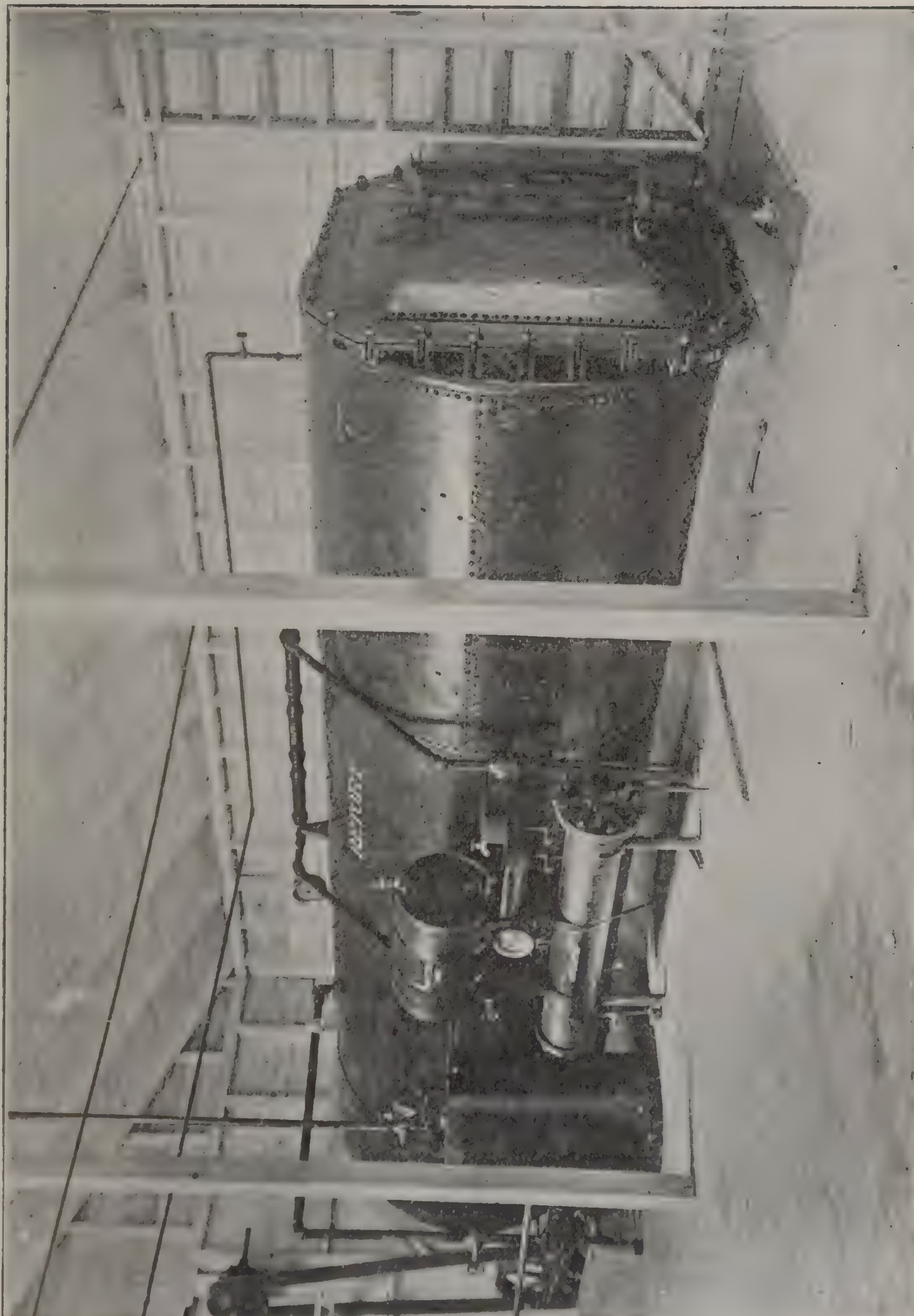


FIG. 101.—Apparatus for fumigating in a vacuum, imports of foreign cotton. (Photo by L. A. Whitney.)

has a working capacity of 5 cars or 75 bales of cotton. Fumigation is conducted as follows: When the charge of cotton is in the chamber the doors are closed and clamped and the air is exhausted until the gauge registers 25 inches. At this stage the gas is generated by introducing into the generator the chemicals in the following order: water, acid and cyanide in solution. The cyanide solution is run into the generator at a rate that will require from 8 to 10 minutes for all of the solution to be introduced. At the expiration of 15 minutes air is permitted to pass through the generator for 5 minutes to wash out all gas that may be in the generator and then the valve between the generator and the chamber is closed. At this stage the air is admitted into the chamber until the vacuum gauge on the same falls to 5 inches. The cotton is held in the presence of the gas for one hour and 25 minutes additional, making the complete exposure one hour and 45 minutes. The formula for fumigating cotton is 6 ounces avoirdupois sodium cyanide, 6 fluid ounces of sulphuric acid and 6 fluid ounces of water for each 100 cubic feet of chamber space. For all grades of cotton waste as specified the formula is 9 ounces avoirdupois of sodium cyanide to each 100 cubic feet of chamber space. All imported cotton, even to broker's samples, goes through this drastic disinfection process before being permitted to leave the port of entry for distribution in the United States.

The foregoing regulations and operations were promulgated and devised in an effort to keep out of the United States insects known to work injury to growing cotton in foreign countries, but there are insects very injurious to growing cotton that are widely distributed in the older cotton growing states of the United States, and to keep these out of the state of California is one of the duties of the Quarantine Division of the State Commission of Horticulture. The Mexican Boll Weevil, *Anthonomus grandis,* is the particular one against which the provisions of Quarantine Order No. 26 are directed. What this insect has cost and is costing the cotton growers of our southern states can not be comprehended by simply printing an array of numerals indicating dollars lost or expended. Congress made the first appropriation of $250,000 in 1904 to commence the fight against the ravages of this pest. Both the campaign and the appropriations have continued throughout the past 12 years and the battle and the appropriations are still going on as is made evident by the introduction of the bill, H. R. 7536, asking the present Congress for $1,000,000 to continue the fight against the Mexican Boll Weevil. This specific sum asked for the purpose of fighting a single species of insect pest would maintain the Horticultural Quarantine Division of this state on its present basis for a term of 50 years. Prevention is better than cure, and the members of the quarantine service are making a concerted effort to prevent the necessity of appropriating such sums of money to fight the Mexican Boll Weevil in California, and herewith are recorded and portrayed some of the methods employed to accomplish this purpose.

Fig. 103 represents the Mexican Boll Weevil and the cotton boll in which it was found and also illustrates the point that while the provisions of Quarantine Order No. 26 issued by the State Commissioner of Horticulture prohibits the entrance into California for any purpose whatsoever of cotton seed grown in any locality where the boll weevil is known to exist, the same does not prevent attempts to bring in such

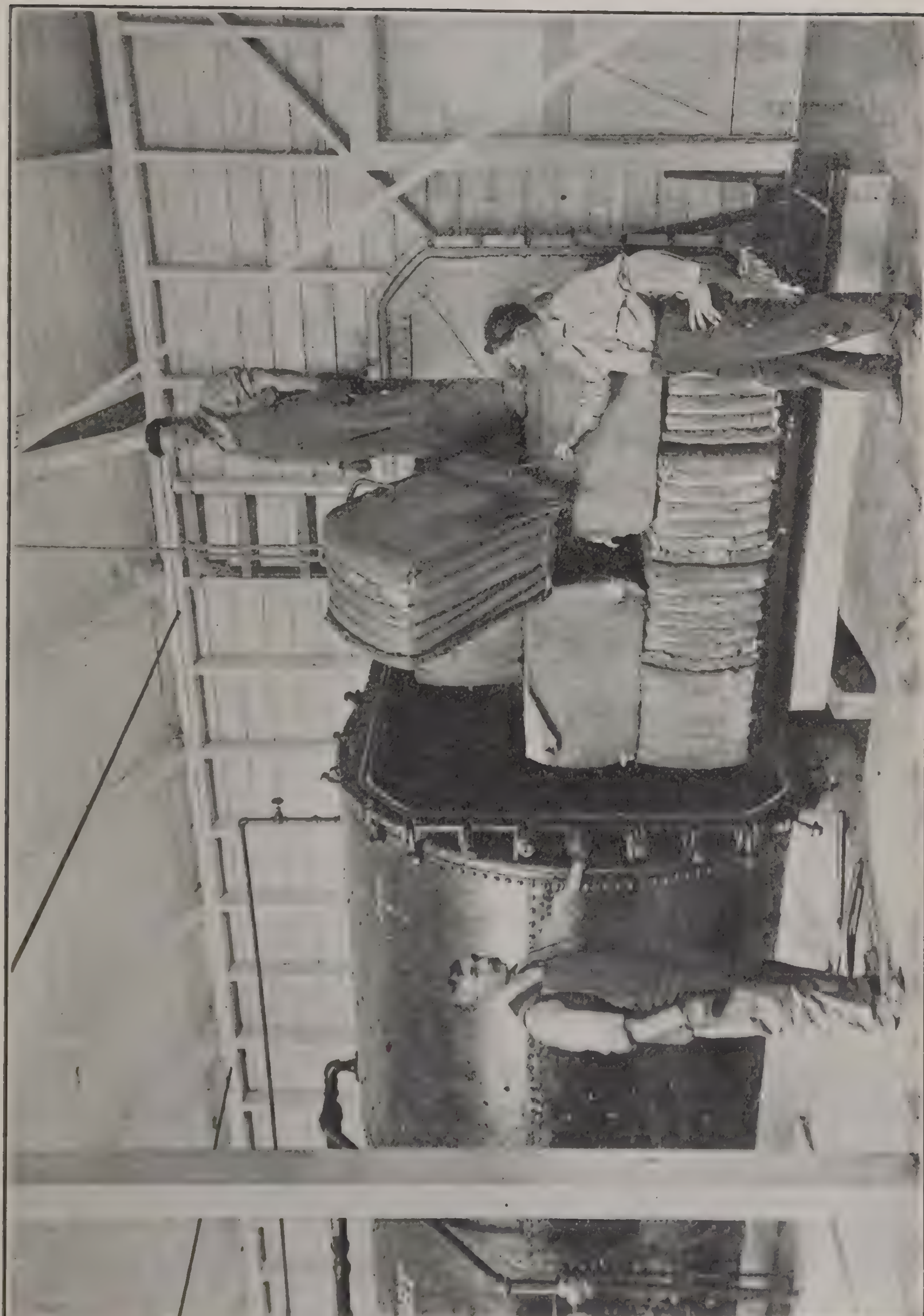


FIG. 102.—Loading bales of foreign cotton into the vacuum chamber for fumigation. (Photo by L. A. Whitney.)

seed. Prevention takes place when a diligent quarantine inspector armed with authority intercepts the shipment and executes the provisions of the order. The Boll Weevil in the illustration was found in a shipment of cotton seed sent into California for planting purposes, intercepted and examined by the quarantine inspectors and as a result of the findings returned to the point of shipment.

Fig. 104 shows cotton seed that came into California in the form of a very unique and interesting advertising device, through the medium of the United States mail. Enclosed in an artistic carton was placed a well filled boll of cotton in which were found the seven cotton seeds shown at the lower edge of the photograph, and on the carton was printed directions for planting the seed. A cotton boll that has been attacked by the Boll Weevil would not develop sufficiently well to meet

FIG. 103.—The Mexican Boll Weevil found in a shipment of cotton seed sent to California for planting. Enlarged. (Photo by L. A. Whitney.)

the requirements of this advertising scheme, and perhaps but little danger need be apprehended of introducing the Boll Weevil by such a method, yet the quarantine regulations—as a means of control—make it mandatory upon all persons bringing cotton seed into California to first obtain a permit from the State Commissioner of Horticulture to do so. These regulations apply to such material coming through the mails, after the postal service has delivered the same to the addressee. The application of these regulations at all times and places is the prime purpose for which the quarantine service is maintained and proof of the diligent appliance of the same is furnished by the photograph.

In drafting the provisions of Quarantine Order No. 26, cognizance was taken of the various ways in which cotton seed was being brought into the state other than for purposes of planting or manufacturing. The problem of railroad cars that had been used for hauling cotton lint and cotton seed to and from the fields, gins and warehouses in the southern states and later used for bringing transcontinental freight

into the state of California was provided for in Regulation 4 of that order, to wit:

> Regulation 4. Railroad cars that have been used for the transportation of cotton, cotton lint or cotton seed must immediately upon arrival at California points be thoroughly cleaned of all cotton seed, and such cotton seed shall be burned when removed from the car. All such cars found at any point in California containing cotton seed in or upon any parts thereof shall be amenable to all the regulations of this order, and shall be placed in quarantine by the State Commissioner of Horticulture until said cotton seed is destroyed and the car passed as clean by a state quarantine officer.

The officials of the railroad companies promptly recognized the nature of the situation, and with a knowledge of how the Boll Weevil

Fig. 104.—Cotton seed sent into California by mail. (Photo by A. C. Chatterley.)

can reduce freight tonnage in an infected cotton growing district, expressed themselves as in sympathy with the purpose of the regulations and proffered their full co-operation in the matter. In this instance the problem was to find a practical method of carrying out the regulations in detail. At first divers mechanical means were employed to clean the cars of cotton seeds. All such, while so expensive as to become burdensome, almost prohibitive, were by no means complete, and the outlook for the continuance of the same was not promising. Eventually the writer suggested the use of live steam for this work at the Oakland yards of the Southern Pacific Company.

and the development of this idea is shown in the illustrations that follow:

Fig. 105 shows the preparations made by the Southern Pacific Company at their Oakland yards in California to enable them to comply with the regulations of Quarantine Order No. 26 in the matter of cars found to contain cotton seed, by using live steam as a disinfectant. A spur track was set apart on which are placed all cars in or upon which is found any cotton seed. At the head of this track is stationed a steam boiler capable of maintaining 80 pounds pressure of steam. From the boiler a service pipe runs parallel with the track, with connections for introducing the steam supplied by the boiler into the cars that are in need of disinfection. In the picture this service pipe can be located as the one on which the inspector has placed his foot.

Fig. 106 shows a car during disinfection for cotton seed and the possible presence of insects and diseases of the cotton plant. The

FIG. 105.—Spur track and steam pipe line used for disinfecting cotton cars. (Photo by L. A. Whitney.)

connection from the service pipe up through the floor of the car can be seen as also the steam issuing through the crevices and joints surrounding the doors. This method of using steam as a disinfectant for this purpose has solved the problem both from the standpoint of economy and efficiency. The volume of steam searches out every crack, niche and cranny, under the floor and behind the lining; all cotton seed in or upon the car is cooked until it is soft, and as a result of a temperature high enough to accomplish this, all forms of insect life that may be present are destroyed. Eight cars can be

disinfected by the present plant at one time. The length of treatment needed to secure results is governed by the number of cars being treated. For one car, one and one-half hours would be sufficient; for six cars, three hours is required. This difference in time of treatment is due to the varying volume of steam consumed and the corresponding fluctuation of pressure at the boiler.

Fig. 107 represents a similar method of disinfecting cotton cars at the Western Pacific railroad yards at Oakland. The process here is the same, but the steam is obtained from a permanent pipe line maintained for other purposes, and the pressure as shown in the photo is much greater. In both instances the method has proven satisfactory, and has become a part of the routine work of the yards

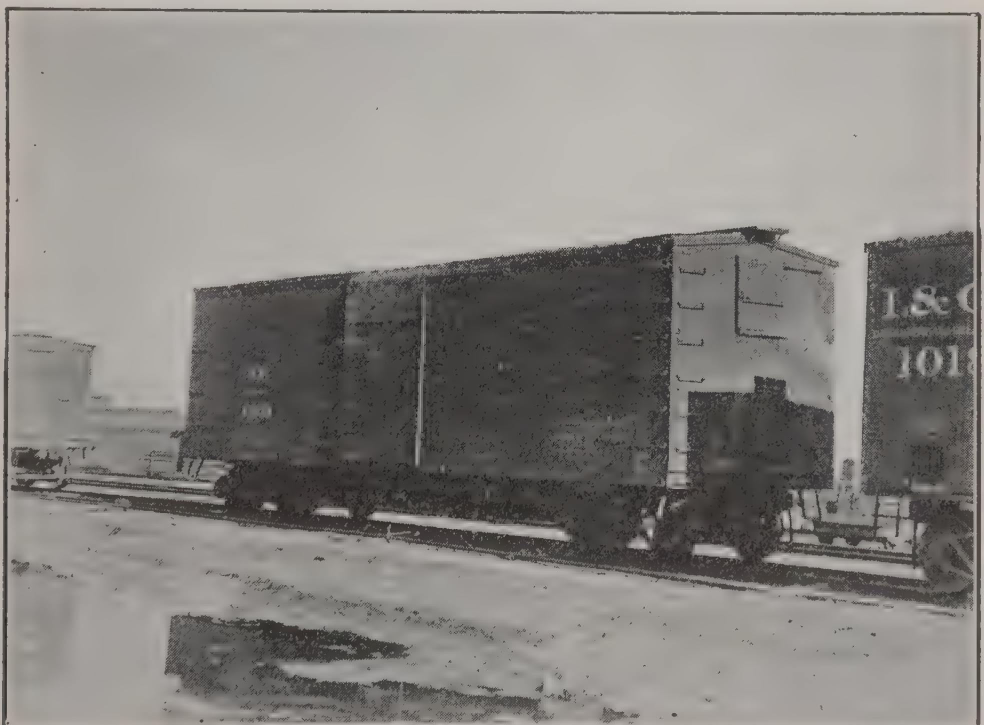


Fig. 106.—A car in which cotton seed was found being disinfected with steam. (Photo by L. A. Whitney.)

and goes on as regularly and as thoroughly as does any other phase of the railroad business.

There is yet another feature of this cleaning of railroad cars, and is concerned with what is known as "Reefers." In this type of car the sides and ends are sided with smooth ceiling material up to the roof of the car, and in such cars cotton seed can be swept, collected and burned with satisfactory results. In the effort to comply with horticultural quarantine regulations, and in an endeavor to keep the Boll Weevil out of California, the several railroad companies co-operate to the extent of cleaning by the different methods enumerated an average of 200 cars a month in the Bay regions around San Francisco. This is both capable and expensive co-operation and is worthy of thoughtful consideration by the cotton growers of the state.

In reviewing what I have written on this matter of the regulations of the federal and state governments in their efforts to protect the

cotton producers by keeping the Boll Weevil and the Pink Boll Worm out of their fields, with a peculiarly intimate knowledge of the painstaking work of the inspectors detailed to enforce these regulations at all times and under all conditions, together with the support and co-operation received from the transportation companies, I feel that

FIG. 107.—Volume of steam used for disinfecting cotton cars. (Photo by L. A. Whitney.)

if the cotton growers themselves universally manifest a similar spirit and interest in these protective measures and co-operate with the quarantine inspectors in maintaining, upholding and enforcing the same, the advent of either of these cotton pests into the Imperial Valley will be relegated to a far distant date.

A COMPARISON OF SOME CITRUS CONDITIONS IN FLORIDA, CUBA AND CALIFORNIA.

By HOWARD S. FAWCETT, Associate Professor of Plant Pathology, Citrus Experiment Station, Riverside, Cal.

INTRODUCTION.

It is the purpose of this article to compare briefly, without going into a scientific discussion, some of the differences in horticultural conditions and practices in California, Florida and Cuba, in special reference to citrus culture. It is fully realized by the author, that some of the conditions and many of the practices are changing so rapidly and are so varied that any general statements about them made from observations two or three years old, may even now be open to serious criticism. A comparison of citrus disease conditions has already been made in Bulletin 262 of the California Agricultural Experiment Station, published in 1915.

FLORIDA AND CALIFORNIA.

Geography and Climate.

Florida with an area of 54,240 square miles, is a little more than one-third that of California with 156,170 square miles, and in population in 1910 with 762,600 inhabitants, Florida had a little less than one-third that of California with 2,377,500. In total amount of citrus fruit raised, according to census of 1910, Florida with 5,970,000 boxes in round numbers, had slightly above one-third that of California with 17,300,000 boxes.

Florida, because of the nature of its geological formation, is a comparatively low country, the highest point being a little over 300 feet above sea level. The topography is concisely described by E. H. Sellards in the Fourth Annual Report of the State Geologist as follows: "Notwithstanding that Florida, the second largest state east of the Mississippi River, is extensive in area, no point within the state is distant from the coast more than 75 miles, and no elevations are found exceeding 300 to 310 feet above sea level. Originally, doubtless, the topography was comparatively simple, the rise in elevation being with minor exceptions, gradual from the coast inland. However, as the result of differential erosion and other factors, well marked topographic types have developed, and at the present time the topography is varied. The key to the topography of the state is obtained by observing the distribution of the limestone and the nonlimestone formations. The importance of limestone formation upon the topography is due to the fact that the limestone is more soluble and more readily eroded than most other formations, and those sections of the state that are underlaid at no considerable depth by limestones have been more radically affected by erosion than the nonlimestone sections, and have been affected in a different manner. The limestones erode chiefly by underground solution, as a result of which sinks, valleys and basins form, giving rise to a characteristic topography. Although limestone formations underlie the state throughout, it is only in limited sections of the state that they are sufficiently near the surface to affect the topography." California, in strong contrast, is a country of extreme differences of elevation intersected and cut up by many mountain chains. To a citrus grower the

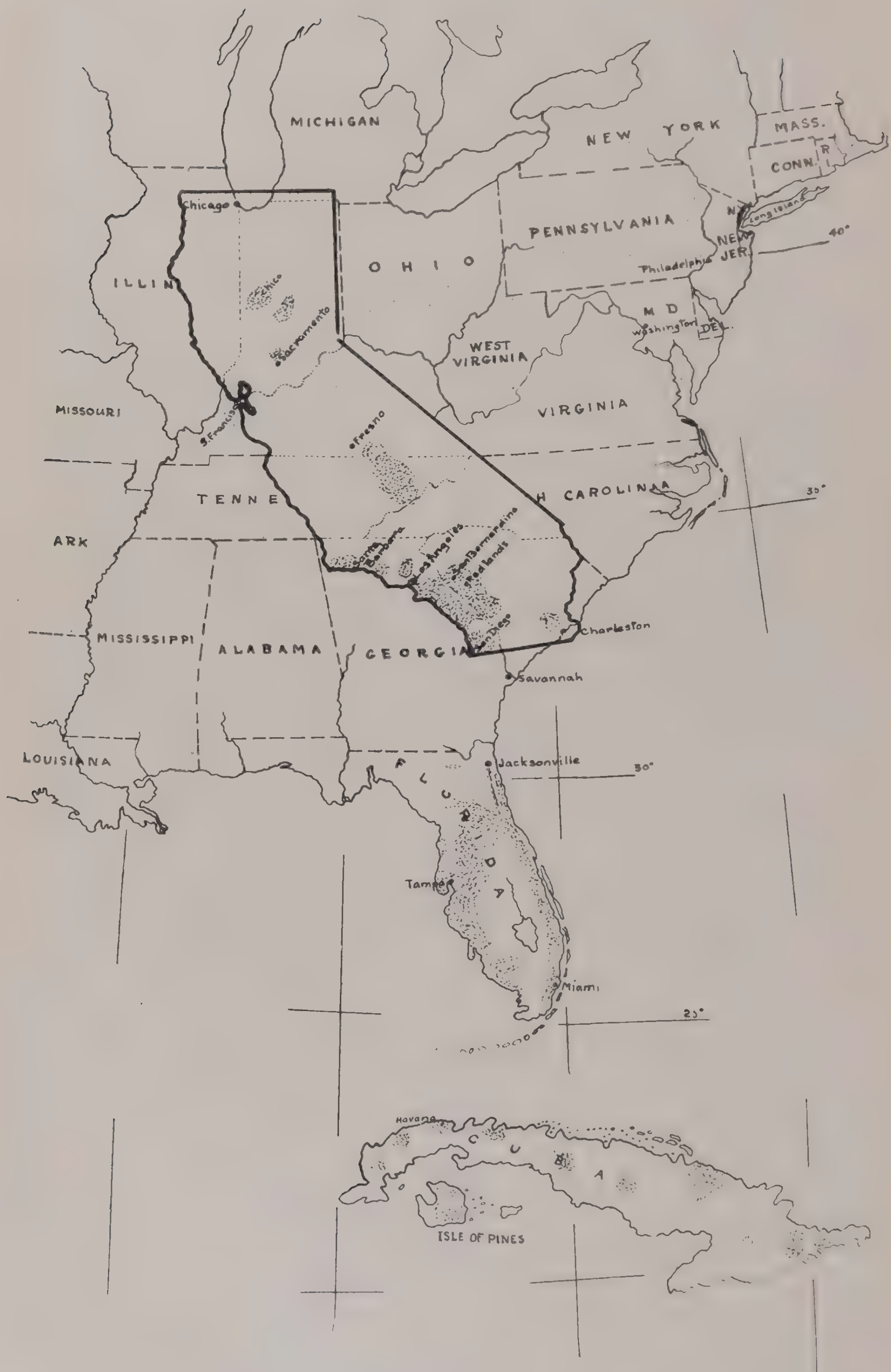


FIG. 108.—Map showing California transcribed upon eastern United States in the same latitude, but its 120th meridian drawn to coincide with the 85th meridian of eastern United States and Florida. Dotted portions show roughly the citrus regions of California, Florida and Cuba. (Original.)

variations in Florida might be summed up in the words, flat woods, low and high hammock lands, rolling pine woods and hills; in California, in the words: alluvial beds, valleys, mesas, foothills, canyons, and mountains.

Florida's principal rainfall (40 to 60 inches) comes largely in the summer and early fall months. In contrast to this California's principal rainfall (10 to 25 inches) is in the winter or early spring months. This is why citrus may be grown in Florida in great part without irrigation, and in California almost entirely dependent upon irrigation. This also accounts for the greater summer humidity of Florida, which makes conditions especially suitable for the development of certain types of fungous diseases which are absent or of minor consequence in California.

Location of Citrus Regions.

In latitude the principal citrus regions of Florida lie between about 25 and 30 degrees north, the same as the middle half of the peninsula of lower California; while the citrus regions of California lie between 32½ and 39½ degrees north, the same as the states between Washington, D. C. and Charleston, South Carolina. (Fig. 108.) In Florida, the temperature (allowing for influences of lakes, rivers and nearness to the ocean varies between localities largely according to the latitude, in California the latitude is a small factor, and altitude, location of mountain ranges and air drainage determine largely the temperature variations between localities. Thus, in Florida, the common expression "south below the frost line" is replaced in California by "on the foothills or mesas above the frost line."

Citrus Soils.

A comparison of soils is not so easily made because of the great variations within both states. Generally speaking, the soils in Florida are quite deficient in plant food as compared to those of California. As water is a prime necessity in California, fertilizers are a prime necessity in almost all types of soils in Florida. On the other hand, humus, rather expensive and difficult to keep up in California, is retained cheaply and rather easily in most conditions in Florida. More will be said of this later.

While the soils in Florida vary greatly, a majority of the citrus groves of the state are on land that would be classed as sandy loam to decidedly sandy soils. Some of these are underlaid with deeper layers of sand, some with clay subsoils and others with limestone. The lands of Florida are usually distinguished by the citrus growers in terms of the vegetation upon them at the time they are cleared. The general terms are: hammocks, pine woods, flat woods, prairies, muck and swamp lands.

Hammock is a term usually applied to land having a heavy growth of trees or shrubs among which the deciduous or hardwood trees or cabbage palmetto predominate. Various modifying terms, as clay and calcareous hammocks, high and low hammocks, shell hammocks and cabbage palmetto hammocks are used for further designation of variations. The thick native hardwood hammocks where oak, magnolia and other trees grow are perhaps the best lands in Florida for citrus growing. In certain parts of the state, these hammocks were found by the early pioneers in citrus culture to contain a thick undergrowth of

wild sour orange trees. The early settlers in clearing out these thickets left a part of the sour orange trees as near as possible in rows and budded the sweet orange into these stocks just where they stood in the hammocks.

FIG. 109.—Orange trees budded on wild sour orange stocks as they were found in a hammock near Orange Lake, Boardman, Florida. (Original.)

For example, Mr. Sampson of Boardman, Florida, one of the early growers, told the writer that about 1874 when he first cleared the land for his grove, bordering what is known as Orange Lake, he found large stumps of sour orange trees that had been killed back years before, probably in the severe freeze of 1835.

FIG. 110.—A typical hammock of cabbage palmetto and hardwood trees near the east coast of Florida being cleared for a citrus grove. Citrus seed-beds in rows in foreground. (Original.)

In addition to these hardwood hammocks, there are also what are known as cabbage palmetto and shell hammocks, terms that somewhat overlap in their meaning. The cabbage palmetto hammocks (Fig. 110), usually rather low and flooded during the rainy season, when properly drained, make excellent land for citrus groves. The shell hammocks, so called because of the large amount of shells in the soil, are common to the east and west coasts and are often palmetto hammocks as well. Groves on these shell hammocks grow excellent fruit but have to be handled with considerable care, as they are quite subject to Exanthema or dieback.

Fig. 111.—Typical rolling pine land of Lake County, showing orange grove to left and long leaved pine to the right, their straight upright growth indicating a good subsoil for citrus. (Original.)

The pine lands may be divided roughly into three kinds: (*a*) the rolling, well-drained pine land, where the long-leaf pine, *Pinus palustris*, is usually the predominating growth (Fig. 111): (*b*) the second grade pine land, also somewhat rolling, where there is an undergrowth of scrub oaks, and where the soil is frequently poorer; (*c*) the spruce pine lands, which are composed of white sand containing an extremely small amount of organic matter. A great many of the best groves in Florida are grown upon the rolling pine lands. The second grade pine lands are looked on with some suspicion, and groves are successfully grown upon spruce pine land only with great care and expense.

Flat woods means land that is more or less level and is usually underlaid with clay, hardpan or rock, and is likely to be temporarily flooded during a part of the rainy season. This land is apt to contain a sparse growth of pines with an undergrowth of saw palmettos (*Serenoa serrulata*) and gallberry bushes (*Ilex glabra*) (Fig. 112). Flat woods lands with clay subsoil are successfully used for citrus groves, those with hardpan are usually avoided.

Prairies or savannahs are level lands usually without trees. These vary greatly in character of soil. Many of them are flooded during a part of the year, especially during the season of summer rains. They are not as extensive nor as important as many of the other lands in the development of citrus groves.

FIG. 112—A flat woods scene, the irregular flat topped growth of some of the pines indicating a subsoil of hardpan unsuitable for citrus. (Original.)

The muck lands are formed by the accumulation of the vegetation that falls into the water and is thus protected from complete decay. The fresh water marshes which are overflowed lands with a heavy growth of coarse grasses frequently are underlaid with muck. E. H. Sellards, State Geologist, in his Fourth Annual Report, says: "The

FIG. 113.—Canal approach to Lake Okeechobee through the muck lands from the headwaters of the Caloosahatchee River. (Original.)

muck and fresh water marsh lands of Florida are extensive, aggregating not less than 5,000 square miles. The everglades of southern Florida (Fig. 113) include the most extensive single area of muck lands, although many smaller areas occur throughout the state.'' The muck lands when drained make perhaps the most fertile soils in the state. Citrus trees will grow well in them, but the fruit is usually coarse, thick-skinned and inferior in quality in comparison to fruit grown in other soils.

The California citrus soils vary from the alluvial sandy loam of the lower valleys through a heavy clay and adobe to decomposed granite of higher altitudes; this last varying in amount of decomposition from fine soil to a point where boulders of considerable size have to be removed from the surface before trees are planted.

Citrus Localities.

With the exception of some groves of Satsuma oranges in northern Florida and a few groves in protected regions along the St. Johns River and in the proximity of lakes, the great majority of all commercial citrus growing in Florida is now carried on in the southern half of the state (the southern half by area and the southern two-thirds by latitude). Before the freeze of 1894–95, however, the center of citrus growing in Florida was 75 to 100 miles farther north than it now is. In the vicinity of some towns in northern Florida which before this date were the largest shipping points for citrus fruit in the state, there can now be found only a few orange trees which have come up from the old roots. This is about the only outward evidence of some of the earliest important citrus growing communities. These same lands, however, are now being profitably employed in the raising of vegetables, sugar cane, corn, sweet potatoes and other crops.

In southern Florida the various citrus sections or regions are not so widely separated in actual distances as those represented by the citrus regions of Butte County, Tulare County and the southern California counties in this state, yet even in Florida, citrus growing, though generally scattered, is apt to become centered and often concentrated somewhat about certain important cities or towns. This is best indicated by mentioning some of the main regions and representative cities. There is first the Lake and Orange county region, an old section with many old seedling orange groves as well as budded varieties, and considerable grapefruit. Representative cities are Eustis and Orlando. Then there is the Polk and Hillborough county section a little farther south, differing little from the last, except perhaps in the larger percentage of grapefruit groves. In this section representative cities are Lakeland, Florence Villa and Tampa. The Pinellas Peninsula and the Manatee River regions near the west coast are two similar regions both well protected from frost by large bodies of water and they now grow large amounts of both grapefruit and oranges. In these sections lemons at one time were successfully grown. Representative cities are Clearwater and Bradentown. Desoto and Lee county sections, represented by Arcadia and Fort Myers, are still farther south, the last named being the most southern section on the west coast. These grow large amounts of both oranges and grapefruit. Then there is the famous Indian River or East Coast section, reaching from above Daytona at the north through West Palm Beach to below Miami on the south.

The oranges in this region have the reputation of being sweeter, thinner skinned and superior in flavor to oranges grown in any other section in Florida. Although oranges predominate in the northern part of this section, grapefruits predominate in the southernmost portion about Miami. This region contains a large amount of calcareous hammock land. In the southernmost region there is much cochina rock and the trees tend to show Chlorosis unless large amounts of organic matter are added to the soil.

In Florida within every local section, with few exceptions, the individual groves are scattered and not in continuous, almost solidly planted areas as is so commonly seen in California. Five to 20 acre orchards are scattered here and there, separated by pine woods or stretches of hammock or flat woods. One reason for this scattered condition within a good citrus region, is that since irrigation is not generally practiced, there is no need for close co-operation in the formation of irrigation districts, and the most favorable spots are first picked out for planting. Then again, large tracts between groves are often held by railroad, lumber, turpentine or phosphate companies, who hinder their development.

Fertilization of Citrus Trees.

Generally speaking, fertilizer is to the Florida grower, what water is to the California grower, the first and prime necessity for the production of profitable crops. The summer rains usually furnish the water, but to the majority of the Florida citrus soils, plant food must be added in liberal quantities. A great variety of fertilizer practice prevails, but perhaps the most common is to apply a ''complete'' fertilizer containing the three elements: nitrogen, potash and phosphoric acid. This is usually put on in from two to four applications. Where three applications are used (which practice is perhaps most common), the first is put on in the early spring; the second in late spring, and the third in the fall. A large proportion of nitrogen is generally used in the spring, and this is reduced somewhat in the summer and fall.

Cultivation Practices.

It would be difficult to make a statement of a method or practice in cultivation of citrus soils prevailing in Florida or California that would not be open to serious question, since the details are varied perhaps more by growers than any other operation of citrus culture. There are, however, certain practices that are more or less common. In Florida, with few exceptions, cultivation is entirely discontinued during the heavy rains of the summer and fall, and resumed after the rains are over. During the dryer part of the year, in winter and early spring, the cultivation on most soils is very shallow. Some growers use a definite summer cover crop, while others leave whatever grass and weeds happen to come up, to grow during the rains. If these get too high and rank, as they sometimes do, they are mowed down and usually left upon the ground. In certain soils where there is an overamount of organic matter already in the soil, this vegetable matter is sometimes removed. It has been found by experience that on many of the Florida soils, cultivation during the rainy season is very injurious to the trees. On soils subject to Exanthema (dieback), this trouble is greatly aggravated by such practice.

Perhaps the most common summer cover crop used at the present time in Florida is Beggarweed (*Meibomia tortuosum*) a native legume. This usually reseeds itself each year and does not require resowing after it is once well established. Velvet beans (*Mucuna utilis*) and cowpeas (*Vigna catjang*) are also sometimes used, but the former is not liked by the growers because of the tendency of the vines to grow into and over the trees. On some of the lower hammock lands, no cultivation is practiced the year around aside from merely hoeing the weeds that come up under the spread of the trees. Many groves grown in such situations without any cultivation are thrifty and profitable (Fig. 115). Professor P. H. Rolfs, Director of the Florida Experiment Station, says: "Some of the best groves in the state are heavily sodded

FIG. 114.—Cover crop of beggarweeds and sandspurs between rows of four-year-old citrus trees on rolling pine land. (Original.)

to Bermuda grass and are not cultivated." This is quite different in many respects from the general cultivation practice in California where in the summer the ground is prepared for irrigation every 30 to 80 days and then worked down again to conserve the moisture. Then, unless water is abundant, instead of a cover crop being grown in California in summer, it is usually grown in winter during the period of rains. Most of the cultivation of the soil, therefore, in Florida is in late fall, winter and early spring (a comparatively dry period) while in California, during this same time, cover crops are grown and practically no cultivation is done.

Varieties of Citrus.

The varieties of citrus fruits generally preferred differ greatly in the two places. In Florida, there are probably 20 to 30 or more different standard varieties of oranges, but in California, there are only

three or four. While in California nearly all oranges are classified under the three names, Navel, Valencia and Seedlings, in Florida a much larger number of varieties are grown and many names are in use, as Parson Brown, Boone's Early, Hart's Late, Valencia, Pineapple Orange, Homosassa, Jaffa, Majorca, Indian River, Seedlings, etc. There are, however, in Florida as in California, a few varieties that are most preferred and more generally planted than others. This will probably result in time in the adoption of three or four standard

FIG. 115.—A low cabbage palmetto hammock of the east coast where orange trees are grown successfully without cultivation. (Original.)

varieties. Professor H. H. Hume, of the Glen Saint Mary Nursery Company, expressed to the writer the opinion that in the case of oranges, about three or four of the present varieties would survive, for example, the Parson Brown for early, the Pineapple orange for medium, and Hart's Late (nearly identical with the Valencia) for a late orange, and the new Lue Gim Gong for an all season orange.

The Parson Brown is a very early orange, which is often quite good to eat even in October, though it may still be quite green on the

exterior at that time. If allowed to remain on the tree too long, say until February, it becomes inferior in quality.

The Pineapple orange is a smooth, thin-skinned fruit, which is somewhat later in its time of maturity. This is now being planted extensively in many sections of the state. In the section where it originated, it has a flavor slightly suggesting that of the pineapple, but when grown in some of the other sections, it seems to lose this characteristic.

The Hart's Late is thought by many to be practically the same as Valencia. The two varieties pass in California under the name of Valencia. The Valencia is being planted to a considerable extent in Florida as a late orange, but its average time of ripening is at least four to eight weeks earlier than in California.

A new orange that is creating considerable interest in Florida, but which has not yet had time to become of much commercial importance, is the Lue Gim Gong. It was developed by a Chinaman of that name, at De Land, Florida. It is said to be a cross between Hart's Late and Mediterranean Sweet. It is a late orange, somewhat like the Valencia, but even later in maturing and has the peculiar quality of keeping good and palatable when left on the tree two, three and even four years. The fruit itself is also said to have stood a lower degree of freezing than the Valencia or other ordinary sweet oranges.

The Washington Navel has apparently never become a successful variety in Florida, though it has been tried repeatedly. Usually the Navel trees in Florida do not bear well and the fruit tends to become too large and in most locations to be lacking in juice.

Besides the ordinary sweet oranges, a considerable number of tangerine and Satsuma oranges are raised. The latter is a rather hardy orange and does best in northern Florida, when budded on *Citrus trifoliata* root stocks.

What has been said as to the large number of standard varieties of oranges cultivated in Florida, is also true in regard to grapefruit or pomelo varieties. Commercially speaking, grapefruits are to Florida what lemons are to California. Perhaps at present nearly half of all the new plantings of citrus fruits in Florida are to grapefruit. Some of the most important varieties of grapefruit are the Duncan, Hall's Silver Cluster, Walters, Pernambuco and Marsh Seedless. The Marsh Seedless is the principal variety now planted in California. The quality of the Marsh Seedless in Florida, however, is not considered by many so good as some of the varieties with seeds. It is not considered to have so good a flavor there except when held very late in the season.

Lemon growing is commercially nonexistent in Florida. The last commercial orchard, one of forty acres, located on the shore of Tampa Bay, was budded over to grapefruit about 1911, and with it the lemon industry died completely in the state. Although nearly every grower has a lemon tree or two in his yard for his own use, the writer could not find in the whole state even a half acre of lemons in one body. There are probably several reasons why lemon growing was discontinued in Florida. Professor P. H. Rolfs says the main reason was that the fruit grew too large. Another reason was that lemons in Florida are severely attacked by the rust mite and by scab, both of which have to be fought continually in order to keep the fruit bright.

Some limes are being raised commercially in the southern part of the state, especially on the islands composing the Florida Keys, where natural thickets of lime trees grow. The withertip fungus (*Glœosporium limetticolum*), however, interferes greatly with the crop as well as with the growth of the trees in these places.

Stocks.

The four citrus stocks most used in Florida at the present time appear to be sour orange, rough lemon, *Citrus trifoliata* and grapefruit; in California, the principal stocks used are sweet and sour orange. Sour orange in Florida is probably used more than any other, and grapefruit appears to be used less than formerly. The sour orange stock, now being used extensively in California because of its great resistance to the gum diseases, has for years been used in Florida to replace the sweet orange stock because of its resistance also to the gum disease known as foot rot or Mal di gomma there. Sour orange is especially desirable on low moist hammock soils, where there is most danger from this disease. California growers have, until recently, used more sweet orange stock than any other. In Florida, the rough lemon is preferred by some for rather high, loose sandy land, because it appears to push the growth of the tree faster during the first few years. It is also said to be a more vigorous feeder and to stand more drought than other stocks. The objections that have been raised against the rough lemon stock is that it appears in many cases to cause the fruit (oranges especially) for the first few years to be coarse, pithy and dry. The *Citrus trifoliata* stock is used extensively for the Satsuma orange, a hardy variety planted in northern Florida and the other Gulf states because of its resistance to frost. This stock appears to have the influence of somewhat dwarfing most varieties of citrus trees.

CITRUS CONDITIONS IN CUBA.

According to statistics published in 1913 by the *Cuba News* of Havana, there were at that time less than 20,000 acres of citrus growing commercially in Cuba and the Isle of Pines, most of it under 12 years of age. This did not include the older scattered citrus trees throughout the islands. In round numbers, about 14,000 acres of this were in grapefruit, 5,000 acres were in oranges and 800 acres in lemons. Most attention is being paid in Cuba to grapefruit for shipping, oranges being grown principally for local consumption, and little attention is now being paid to lemons. With a few exceptions, the lemon orchards are considered unprofitable and are mostly being neglected or budded over to other citrus varieties. It would seem, however, that with proper care, lemon growing could be made profitable in Cuba. Several growers who have taken pains with their crop are reported to have received good returns. The Cubans themselves eat very little grapefruit, but are very fond of what we would term over-sweet, insipid oranges. It was estimated by a large fruit buyer that the city of Havana consumed an average of 100,000 such oranges daily the year around. These oranges for local consumption are not picked until they are quite sweet and are shipped from the outlying provinces in bulk in the cars without being put in boxes and are handled in a very rough manner.

In climatic conditions, Cuba and the Isle of Pines are similar in many respects to southern Florida. The rainy season occurs in summer and

the drier period in winter the same as in Florida. Cuba and the Isle of Pines being between 20 and 23 degrees north latitude, have one great advantage over most of the citrus regions of Florida and California, and that is the total freedom from frost injury. The most tender varieties of citrus and tropical fruits may be raised without danger from such injury.

Soils.

Although there are some citrus soils in Cuba of the sandy type, like those of the most of Florida, the soils in general are much richer in plant food, and in that respect appear to compare more nearly with those of California. They are extremely variable and hard to classify. This variableness is indicated by the following list of ten types of soil given the writer by Professor F. S. Earle:

1. *Deep sandy pine lands.*—Almost pure sand for at least four feet, then mixed with clay.
2. *Gravelly pine lands.*—Four to ten inches. Subsoil reddish clay with some admixture of sand.
3. *Paratejo Sabanas.*—Open grass lands, often with cabbage palms. Surface soil much like No. 2, but usually rather stiffer and the subsoil decidedly stiffer.
4. *Royal Palm Sabanas* (Tobacco Lands).—Surface reddish or brownish loam, 6 to 12 inches. Subsoil reddish or yellowish clay, usually overlying limestone, usually more or less fragmentary and permeable.
5. *The Red Lands.*—One of the best types of cane land. Made by the weathering of coral rock. Texture of the loess soils but stiffer. No subsoil. Extending down unchanged to the coral bed rock. Perfect natural underdrainage.
6. *Heavy black soils* with rotten limestone subsoils. These soils give trouble if subsoil is too near the surface.
7. *Heavy black soils* with stiff clay subsoil. Require care as to drainage, but sometimes give good results.
8. *Black* rather heavy loam underlaid with fragmentary serpentine rock.
9. *Iron gravel soils.*—Deep deposits of red iron gravel. These often carry 20 to 25 per cent of iron.
10. *Mulatto Lands.*—Stiff brownish soils made from decomposing shales.

Professor Earle adds: "This list could be considerably extended and each heading could be subdivided, since our soils are extremely variable in character."

The lands on which most of the citrus is planted would perhaps go roughly into about four classes as follows:

1. Heavy clay soils, grey to black in color, underlaid with clay or marl or sometimes rock, rather rich in plant food, and hard to work.
2. The red clay soils varying in depth but some of it very deep, underlaid usually with coral or limestone, easier to work than the last and perhaps one of the best for citrus.
3. Sandy loam underlaid with clay at varying distances.
4. Sandy soils containing a small amount of organic matter, sometimes very deep, often underlaid with permeable clay at varying distances.

The last two classes correspond most nearly to the average citrus lands in Florida.

Cultivation and Noncultivation.

The method of cultivation varies a great deal from clean cultivation the entire year to no cultivation at all, and these extremes vary with different degrees to mulching and growing of cover grops. The writer was much impressed with the effects of a heavy vegetable mulch over the soil in several places where this had been continued for a number of years in succession.

At Herradura, Professor F. S. Earle showed the writer a grapefruit grove on clay loam soil underlaid with stiff clay where part of the grove had been mulched all over the ground. The soil in this orchard was uniform and the trees were all of the same age—seven years. Part of the rows had been heavily mulched all over the ground with vegetable

FIG. 116.—Grapefruit grove ten years old at Santiago de las Vegas on heavy red soil. The ground has been covered with a thick vegetable mulch for the past five years, during which time no cultivation has been carried on. (Original.)

matter, grass and weeds for three years, part of it for two years, part for one and a half years, and another part for nine months only. A few rows in the middle of the orchard had not been mulched at all, but had been plowed and cultivated to conserve moisture during the dry season, during the whole period of seven years. The difference between the mulched and unmulched trees was very marked and almost beyond belief. The trees mulched for three years past without cultivation had foliage of good color, were vigorous, comparatively free from scale insects, bearing a large amount of smooth skinned, bright fruit, and the trees were two to four times as large in diameter of trunk and two to four times as large in spread of branches. The trees were also free from Chlorosis. On the unmulched tract the trees were small, stunted, with small yellow, starved looking leaves, with limbs dying

back and with only a very few fruits, these being russeted and inferior in quality. There was at least four to six times as much fruit on the mulched as on the unmulched. The trees mulched for two years instead of three also showed a proportional improvement. Even the trees mulched for only nine months showed marked improvement in color and the amount of the last new growth. The improvement in this orchard was in definite proportion to the length of time the soil had been covered with vegetable mulch. Professor F. S. Earle is of the opinion that the secret of the success of mulching lies largely in the shading of the soil. He believes that in hot weather the sun interferes with work of the soil bacteria, and the normal formation of humus. Wherever direct comparison could be made, it seemed to the writer that the system of mulching or keeping the soil shaded in some way had a great advantage over clean cultivation for keeping trees in good healthy condition as well as helping to keep the fruit bright under the conditions existing in that country.

FIG. 117.—A large citrus planting in Cuba on a dark heavy clay loam soil. Trees set about five years. (Photo by H. O. Neville.)

At Santiago de las Vegas on heavy, red, sticky soil, Mr. H. A. Van Herman had been mulching heavily all over the soil for the last five years, and had stopped cultivating entirely during that time. Previous to that he had practiced deep and frequent cultivation and the trees were said to have gone back rather than gone forward. Since beginning this heavy mulching, the trees have grown rapidly, are healthy and green in appearance, and have on them a large crop of fruit. Mr. Van Herman was one of the first to advocate heavy mulching all over the ground as a general practice in Cuba. He is convinced that it is the proper practice for most soils in a climatic condition like that of Cuba.

Some excellent groves were seen, however, on red clay soils, and also on deep clay loam soils where a system of nearly clean cultivation was used plowing in large amounts of organic matter and fertilizing liberally with commercial fertilizer. Many growers were placing vegetable

mulch directly under the trees, but cultivating and raising summer cover crops between the rows. One of the most interesting cover crops seen was the pigeon pea (*Cajanus indicus*), which grows very tall and woody. This crop appeared to give excellent results when grown between the rows of young trees so as to both shade them and serve as a partial windbreak.

Fertilization.

In Cuba as in Florida there is a great diversity of fertilizer practice. A considerable amount of commercial fertilizer was being used on the poorer soils with apparently excellent results.

The effect of the addition of organic nitrogenous fertilizer at Herradura on a clay loam soil was also of much interest. It is well known that in Florida on most citrus soils the addition of large quantities of such fertilizer is likely to bring on Exanthema or dieback. On this place there were certain grapefruit trees where chickens had been roosting and large amounts of droppings had gone on to the soil. These trees, contrary to what one would expect from Florida experience, were much healthier and more vigorous than those not receiving these droppings, and not the slightest indication of Exanthema was apparent. The fruit was more abundant and brighter than that in the other part of the orchard. Another set of trees had been growing inside of a pen where hogs had been kept for some time. Some months had elapsed since the pen had been discontinued. The trees showed a distinct evidence of benefit also from this treatment. On most soils in Florida, either the constant droppings from the chickens or the hog penning would have been almost certain to have brought on Exanthema and caused a large amount of injury to the trees. In this connection, it may be of interest to note that not a single case of Exanthema (dieback) was seen on the Island of Cuba, and Professor F. S. Earle tells me he has never seen it there. Only one case of Exanthema was seen on the Isle of Pines and that was where the subsoil was stiff clay and where the drainage was very poor. In several places in Cuba where the drainage was also poor and where one would expect to find Exanthema, none could be found.

SUMMARY.

To sum up briefly some of the principal differences between citrus conditions and practices in Florida and California:

1. Florida's citrus regions lie between about 25 to 30 degrees north latitude with 40 to 60 inches of rainfall during late spring, summer and early fall. California's citrus regions lie between 32½ and 39½ degrees with 10 to 20 inches of rainfall during late fall, winter and early spring.

2. Florida, therefore, has a moist, humid atmosphere during most of the growing season, making it possible to grow citrus fruits without irrigation, while California, during this same season, has a dry atmosphere without rains, making it necessary to practice irrigation.

3. In Florida, cultivation is usually discontinued throughout the rainy season of summer, and in California is usually kept up during the summer because of the necessity of frequent irrigations and the conservation of moisture in the soil.

4. In Florida cover crops of Beggarweed, cowpeas, velvet beans, etc., are grown in summer, while in California, unless irrigation water is plentiful, summer cover crops give way to winter cover crops of vetch, Melilotus, etc.

5. In Florida the soils are generally light and sandy and require large amounts of plant food for the best growth of citrus fruits, while in California, although the citrus soils are much more variable, they average much heavier with a greater amount of clay, therefore, much richer in plant food.

6. The large number of standard varieties of both oranges and grapefruit in Florida give way to only a few standard varieties of oranges and one standard variety (Marsh Seedless) of grapefruit in California.

7. Lemons, not now grown commercially in Florida, are a very important crop in California, while grapefruit, on the other hand, is a very important crop in Florida and is of only secondary importance in California.

8. What is said in paragraphs 1, 2, 3 and 4 in regard to Florida, is true for the most part as regards Cuba, except that Cuba lies between about 19 and 22 degrees north latitude, and that the application to the soil of a continuous cover of vegetable mulch is practiced more extensively.

9. The average soil of Cuba is heavier and richer in plant food than in Florida. Lemons not grown in Florida are grown commercially to a small extent in Cuba, and grapefruit occupies three-fourths of the commercial plantings.

LAWNS OR WEEDS.

By O. W. Newman.

There are probably as many questions propounded each year asking how to eradicate weeds from lawns and flower gardens, as come from most other lines of agriculture combined. This evident desire on the part of many individuals to keep their grounds clean and presentable at all times deserves more serious consideration than it has been receiving.

Without doubt one of the most difficult problems in California is to keep lawns in good condition. A great deal of money is spent each year in replacing lawns overrun with weeds of one kind or another. A considerable amount of this expense could be averted, however, if the underlying causes of said expense were known. Four-fifths of the trouble from weed pests in our gardens and lawns could easily be saved if we devoted care beforehand to see that we started right. More care should be taken in the selection of lawn and other grass seeds than with any other class of seeds. Some seed houses make a specialty of lawn mixtures, and many of these are no doubt of high quality, but on the whole grass seed is handled as a side issue and as a result is apt to contain impurities of almost any nature. Before making a purchase, therefore, the greatest care should be taken; samples should be sent to the state university for test of both cleanness and germinating quality. Clean seed is not of much value unless a good per cent of it will germinate. The best seed is none too good; never buy cheap

seed. To illustrate this, let me quote from Mr. Gilbert H. Hicks, formerly Assistant Botanist of United States Department of Agriculture:

'A sample of Canada blue grass offered to the United States Department of Agriculture contained eleven kinds of foreign seeds, principally weeds. Of seventeen samples of this species examined, fifteen contained seeds of Canada thistle or the spines, indicating the probable presence of this pest. Meadow foxtail from Germany, offered for 30 cents a pound, contained only a little more than one-quarter (27.5 per cent) pure seed, the balance being about evenly divided between chaff and foreign seeds, principally English rye grass worth about 10 cents a pound.

"Red top seed offered as 'fancy' at 18 cents a pound contained foreign seeds at the rate of 283,000 to the pound. A sample of Rhode Island bent contained 2 per cent of that species, 70 per cent being chaff, and 21 per cent another species of bent, while the balance (7 per cent) was dirt and weed seeds. Another sample of Rhode Island bent contained none of this species whatever, but consisted of 57 per cent of another species, 40 per cent chaff and dirt, and 3 per cent weed seed, including twelve kinds.

"Some of the so-called 'lawn mixtures' upon the market are the veriest frauds, consisting of a lot of inferior grass seeds mixed with chaff and various impurities, practically the sweepings of the seed merchant, but invariably sold at the price of high-grade grass seed. A sample of lawn mixture purchased in a nearby market contained 45 per cent impurities, principally chaff and dirt. Among the weed seeds present were sorrel, pigweed, three kinds of plantain, pepper grass and stink grass. In general it is better for the buyer to make his own lawn mixture after consulting a reliable person as to the most suitable varieties for his case, and the proper proportions in which they should be used."

We have on file in this office reports of a similar nature from the state university and from various county horticultural commissioners in the state which prove that California is no exception to the rule.

There is another source of trouble to the lawn maker in the city and that is the neighbors. There is constant danger of migratory weeds coming from the neighboring yards. This, of course, can not be helped unless one can prove that the adjoining property is a nuisance and have it condemned as such. Most of the trouble of this sort, however, comes from vacant lots and waste places which have been allowed to run wild. Most weeds found in the cities are what are known as migratory weeds. That is, by their very nature they are spread rapidly. They come to the city in straw packing, in hay, grain and manure, in railroad cars, and in the hair of stock. They find their way into the vacant lots of the city and from there proceed to inhabit the surrounding lands. It is interesting to note that many of the weeds recently reported from the western states have come first to the cities, and from there have been transported into the country. Canada thistle has made periodical migrations westward arriving first in the cities and thence taking permanent residence in the neighborhood. The Russian thistle, prickly lettuce, sneezeweed and star thistle have all been traced to the large cities in each state as the source of distribution.

The above facts place great responsibility on the city governments which ought to be recognized. It has been said that the Illinois law against Canada thistle would absolutely control that pest were it not for reinfestation by seeds blown and transported from the city of Chicago and other large towns in that state. The public welfare demands that every city awaken to its responsibility and start an annual cleanup campaign. The agricultural interests of the state should demand that a general policy of cleanness be inaugurated and carried out.

This can be and has been accomplished by many cities by turning its vacant lots over to the public, as parks and playgrounds, as free agricultural plots, as places for school gardens and the like. Where large areas are going to waste the city park commission should pasture

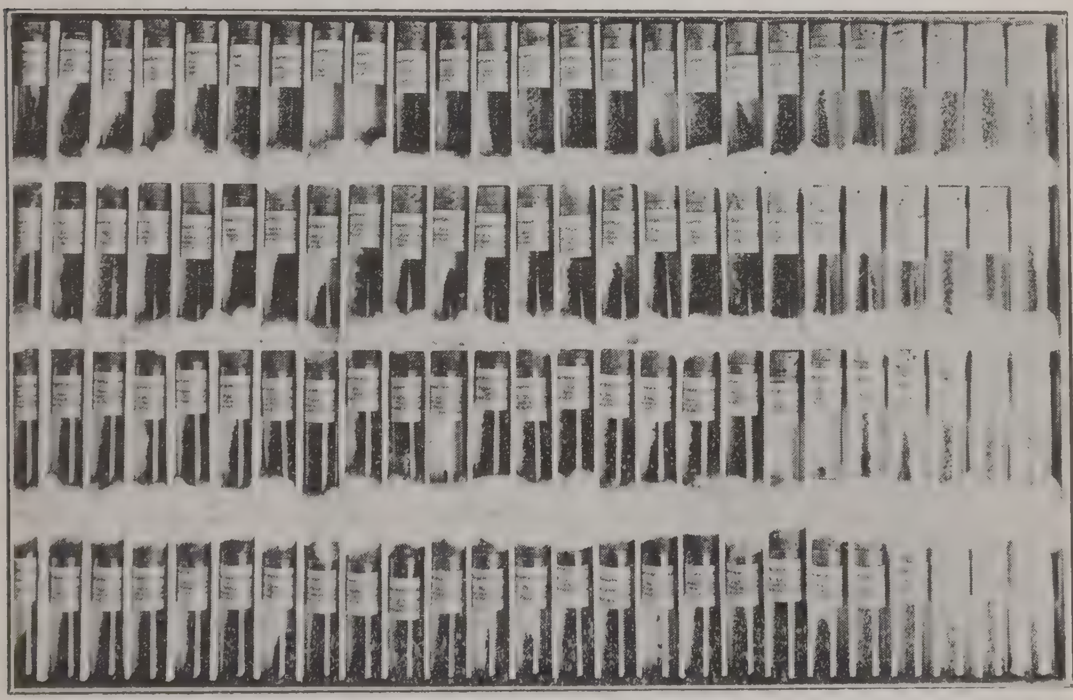


FIG. 118.—A set of 100 weed seeds found in agricultural seed. This can be obtained from the U. S. Department of Agriculture, at a cost of $1.75. (Original.)

sheep and goats. This has been tried in many large eastern parks and found of great value economically. Municipal legislation should establish park and street superintendents, and it should be their duty to keep the streets and lots clean to the best of their ability.

WALKS AND STREETS.

It is an easy matter to keep walks and streets free from weeds. Here the soil is of no value and chemicals can be applied which will sterilize and thus prevent all growth. In the city of Sacramento street cleaners spend hours digging and hacking at Bermuda grass patches which could be removed in five minutes by the application of a little distillate. Such chemicals as distillate, copper sulphate 6 per cent solution, salt or any strong soil-killing chemical will remove all weed growths from walks and drives for a period of several months. Material should be sprinkled on with an ordinary sprinkling pot to get the best results.

LAWNS.

As a general rule if there is good soil and good drainage and good seed used in starting the lawn there will be little trouble from weeds or other pests. Here let me say that every gardener and every prospective lawn maker should have a copy of Farmers Bulletin 494, published by the United States Department of Agriculture.

According to the law of the survival of the fittest, plants will settle and thrive where the struggle for existence is such that they can enter into it and prosper. A good stand of grass will leave no room for weeds. Before planting a lawn see that there is plenty of well-rotted manure spaded into the plot. Test the soil and see that it is not acid. If it is, add some lime and look well to the drainage. Then always use the best seed. Cheap seed is throwing money away. Use plenty of seed and plenty of water. As soon as the first weeds appear pull them out. If any thin spots appear rake them over and sprinkle a little more seed around and roll it down.

In old lawns there is often a great variety of weeds, many of which could be eliminated by pulling. However, care must be taken to see that too much disturbance to the grass is not made in pulling out the weeds. Crab grass, foxtail and small pig weeds can be extracted easly if not too numerous. As soon, however, as the roots become too large, they should be cut with a knife or spud, a tool like a chisel with a long handle, with which the root can be severed just below the crown. Crab grass and other wild grasses sometimes become quite serious pests in lawns. They turn brown at the first touch of frost and leave large patches in the lawn. Bermuda grass has the same characteristic of turning brown at the approach of winter. Such patches should be marked and in the spring worked over, fertilized and reseeded. It is best to keep a lawn cut short all the time to prevent foreign grasses and weeds from going to seed.

So much for the general condition of lawns in their resistance to weed pests. There are, however, several weeds which, if once started, are more difficult to eradicate than foxtail and ordinary pigweeds, for example, crab grass, plantain, dandelion, sedge, Bermuda grass, prostrate pigweed and joint grass. These, the writer intends to take up individually as space and time permit.

CRAB GRASS.

Digitaria sanguinale.

Crab grass is an annual, very widely distributed throughout the United States. It is found in great abundance in the Sacramento and San Joaquin valleys. It grows from a thick spreading root, sending up a quantity of leafy stems which finally fall over and take root at the nodes. It is especially abundant in moist places, and is most rapid of growth during the warm season. At the first approach of frost it turns a yellowish brown. Crab grass is recognizable by its pale green color, its long stems with swollen nodes and the usual accompaniment of small roots, and by its long finger-like panicle or floral head. It grows so readily from seed that it frequently gets the best of blue grass or clover, especially where these are a little thin, and causes very unsightly patches in the lawn.

Eradication.

Crab grass can not be killed out of a lawn by mowing, as it immediately sprouts from the crown. The first principle in such cases is to pull each plant by hand, though this is often a very tedious method. In a blue grass lawn thorough use of a fine toothed garden rake will eliminate a large per cent of such weeds without materially injuring the lawn. After raking, seed down the infested areas with more grass seed, put on a dressing of well pulverized manure or fertilizer, tamp the soil down smooth and water. If the infestation is very heavy the best method of eradication is to turn the sod under and reseed.

FIG. 119.—Common plaintain, *Plantago major*, showing the character of the plant and root as it appears in the lawn. Note the spread of the roots. (Original.)

COMMON PLANTAIN.

Plantago major.

Common plantain is a perennial growing from a short, thick rootstock. The leaves are round-ovate, averaging 3 to 6 inches long, with very strongly marked longitudinal ribs. The leaves form a rosette at the surface of the ground, there being practically no stem. The flowers are in a close whorl along a spike about 2 inches long at the top of a long slender leafless scape 6 to 8 inches in length. The roots are long, fibrous and tough. The color of the plant is a deep sea green. Jepson, in his "Flora of Western and Middle California," describes the migratory habit of plantain as follows: "Probably introduced from Europe. Called by the Indians 'White Man's Foot,' since it has closely followed the advance of civilization, springing up about the earliest frontier settlements."

Eradication.

Plantain seed is very common in all grass seed and great care should be taken to see that seed for lawns is the best and cleanest on the market. Cheap seed is never a bargain. The seed is much smaller than clover seed and can easily be removed from it.

Plantain will push its way into any kind of a lawn, even into Bermuda grass. When an old lawn becomes infested with this weed the best method of removing it is with a spud. Sever the upper portion of the plant from the roots just below the surface of the

ground. This method is very rapid and a considerable area can be covered in a few hours. Rake all plants together and burn. Burning is necessary because the seed frequently matures sufficiently in drying to fall from the head. Such seed is just as viable as fully-matured seed.

It is not advisable to pull up plantains by hand, as the root system is so large that considerable damage will be done to the surrounding grass. In cases of very serious infestation it may be advisable to resort to spraying. For this the most commonly used material is iron sulphate, 40 pounds to 25 gallons of water. Spray with a small hand sprayer, using as much force as possible.

FIG. 120.—A foot pump of great efficiency. Such a pump is better operated by two persons to get the best results. (Commission of Horticulture.)

There have been several other chemical remedies recommended which might prove equally as satisfactory, such as bluestone, 2 pounds to 9 gallons of water. A teaspoonful of common salt applied to each plant is a very effective remedy and does not materially affect the grass.

If spraying is tried the lawns should not be watered for at least 24 hours. The best time to spray is in the morning. The grass will probably turn a little brown, especially if the work is thoroughly done, but this will do no harm. Follow the spraying, after 24 to 48 hours, with a good raking, and then apply a light dressing of fertilizer. The lawn will respond with renewed vigor and will be free from weeds.

CROP REPORT AND STATISTICS.

MONTHLY CROP REPORT.

(September 1, 1916.)

By GEO. P. WELDON.

Compiled from the reports of the County Horticultural Commissioners.

County	Almonds (per cent)	Apples (per cent)	Apricots (per cent)	Berries (per cent)	Cherries (per cent)	Figs (per cent)	Grapefruit (per cent)	Lemons (per cent)	Olives (per cent)	Oranges (per cent)	Peaches (per cent)	Pears (per cent)	Plums (per cent)	Prunes (per cent)	Walnuts (per cent)
Alameda	65	#	h	90	h	#	#	#	#	#	#	80	30	30	90
Butte	15	90	h	—	h	100	100	100	25	100	30	70	35	35	----
Colusa	75	#	h	#	#	100	#	#	#	100	75	75	#	65	75
Contra Costa	70	100	h	#	h	#	#	#	70	#	85	65	70	55	100
El Dorado	#	65	#	#	h	#	#	#	#	#	80	60	40	40	#
Fresno	100	#	h	h	#	100	#	100	100	80	60	#	#	#	#
Glenn	100	100	h	100	#	80	100	100	100	100	100	100	#	100	100
Humboldt	#	80	#	#	h	#	#	#	#	#	-----	75	75	75	—
Inyo	#	95	#	#	#	#	#	#	#	#	60	90	#	#	#
Kern	#	60	h	#	#	100	#	#	100	100	85	25	90	80	#
Kings	#	#	h	#	#	#	#	#	#	#	90	#	#	90	#
Lake	75	50	#	#	#	#	#	#	100	#	50	40	#	25	75
Los Angeles	80	100	h	100	#	60	100	90	80	90	85	75	30	#	70
Madera	35	60	h	#	#	60	#	#	90	#	85	#	#	90	#
Marin	#	25	h	—	h	#	#	#	—	#	50	100	100	100	#
Mendocino	60	100	h	50	h	#	#	#	#	#	75	30	#	75	85
Merced	90	#	h	h	h	90	#	#	90	#	70	#	#	#	#
Modoc	-----	20	0	100	0	#	#	#	#	#	0	0	0	#	#
Monterey	75	65	h	50	h	-----	#	#	#	#	50	50	25	30	#
Napa	-----	80	h	-----	h	#	#	#	#	#	60	70	h	40	90
Nevada	50	100	h	h	h	60	#	#	—	100	60	65	40	40	25
Orange	#	100	h	h	—	—	100	100	75	100	h	#	h	#	100
Placer	25	100	h	90	h	90	#	100	70	90	75	70	h	#	#
Riverside	90	75	h	#	h	#	100	90	60	80	80	40	#	75	60
San Benito	100	100	h	—	h	#	#	#	#	#	85	h	#	60	—
Sacramento	65	90	h	100	h	#	100	100	80	95	70	60	65	50	#
San Bernardino	#	50	h	#	h	#	75	90	70	95	60	50	80	80	90
San Diego	70	25	h	h	0	—	100	75	100	100	h	20	25	20	100
San Joaquin	50	h	h	h	h	#	#	#	75	#	75	h	h	60	75
San Luis Obispo	100	90	h	#	#	#	#	#	#	#	90	85	#	95	90
Santa Barbara	#	100	h	#	h	#	100	90	100	#	#	100	#	#	65
Santa Clara	#	60	h	#	h	#	#	#	#	#	75	50	—	55	#
Santa Cruz	#	85	h	75	h	#	#	80	#	#	80	70	—	50	#
Shasta	20	75	h	h	h	75	#	#	10	#	h	h	h	50	75
Siskiyou	#	10	#	40	h	#	#	#	#	#	5	5	5	5	#
Solano†	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----
Sonoma	25	100	h	75	h	#	#	#	-----	#	80	80	75	45	80
Stanislaus	80	75	h	h	h	90	#	100	100	100	h	h	h	100	100
Sutter	75	100	h	100	h	100	#	#	—	#	75	50	75	75	75
Tehama	100	25	h	50	h	-----	#	#	60	-----	65	75	-----	75	#
Tulare	#	100	h	h	#	95	95	95	85	85	85	#	85	95	#
Ventura	#	#	h	h	#	#	—	100	—	100	#	#	#	—	65
Yolo	65	#	h	-----	#	-----	#	#	-----	#	75	80	90	50	#
Yuba	70	100	h	h	h	90	-----	90	60	90	60	110	h	90	60

Figures in table indicate condition of crop in per cent, on the basis of 100 as normal.
— Horticultural commissioner has insufficient information for a report.
Not grown commercially.
† No commissioner in county at present.
h Harvested.

STATISTICS.

Estimated per cent of the total crop of the principal California fruits grown in each of the main producing counties during a season of normal production. Compiled from the reports of the county horticultural commissioners.

County	Almonds (per cent)	Apples (per cent)	Apricots (per cent)	Cherries (per cent)	Figs (per cent)	Lemons (per cent)	Olives (per cent)	Oranges (per cent)	Peaches (per cent)	Pears (per cent)	Plums (per cent)	Prunes (per cent)	Walnuts (per cent)
Alameda	*		14	9						2	*	*	
Butte	12	*		*	3	*	14	*	3	2	*	2	
Colusa	4		*						*	*		*	
Contra Costa	11	*	*	*					*	6	*	*	
El Dorado		*		*					*	3	*		
Fresno			5		53	*	3	*	29			*	
Glenn	*		*								*		
Humboldt		2											
Imperial			*		*								
Inyo		*							*				
Kern		*	*					*	*	*	*	*	
Kings			5						6			*	
Lake	*	*	*						*	8		*	
Los Angeles	2	2	4		*	31	14	26	4	*	3	*	30
Madera	*	*	*		3		2		*			*	
Mendocino		*								*		*	
Merced	*		*		9		*		3				
Modoc													
Monterey	*	12	2	*						*			
Napa	*	*	*	*	*		*		*	4	*	4	
Nevada		3	*	*					*	*	*		
Orange			4			7		10					38
Placer	*	*		3	*		*		6	7	39		
Riverside	3	*	7	*		16	11	14	*	*		*	
Sacramento	6		*	5			5	*	*	18	8	*	
San Benito	*		6	*					*	*	*	3	
San Bernardino		4	4	*		13	7	31	5				2
San Diego	*	*	*			10	5	*	*				
San Joaquin	12		3	25	*		4		8	4	*	*	
San Luis Obispo	*	*	*										
Santa Barbara		*	*	2		*	2						10
Santa Clara	*	*	21	26	*				5	9	18	55	
Santa Cruz		51	3	2					*			*	
Shasta	*	*					*		*	*		*	
Siskiyou		*											
Solano	6		3	10					3	6	16	4	
Sonoma	*	16	*	9	*		5		*	6	*	12	
Stanislaus	6		*	*	5			*	3	*			
Sutter	9				3		*		2	*	*	*	
Tehama	*	*	*		*		11	*	*	2	*	*	
Tulare	*		*		6	5	6	13	9		2	4	
Ventura			6			15		2					20
Yolo	11		5		5		3		2	9	4	2	
Yuba	*				2		3	*	*	*	*		

*Less than 2 per cent of State's normal crop grown in county.

Grape Report.

County	Raisin (per cent)	Table (per cent)	Wine (per cent)	County	Raisin (per cent)	Table (per cent)	Wine (per cent)
Alameda	#	#	25	Orange	—	100	—
Butte	70	70	#	Placer	----	25	----
Colusa	75	75	#	Riverside	#	90	90
Contra Costa	#	80	80	Sacramento	25	25	25
El Dorado	#	40	40	San Bernardino	100	100	100
Fresno	100	100	100	San Diego	100	100	100
Glenn	80	80	#	San Joaquin	#	50	70
Humboldt	#	#	#	San Luis Obispo	#	50	80
Inyo	----	75	----	Santa Barbara	#	#	#
Kern	100	100	100	Santa Clara	—	—	—
Kings	100	100	#	Santa Cruz	#	50	50
Lake	#	#	25	Shasta	60	60	60
Los Angeles	100	100	100	Siskiyou	#	10	#
Madera	110	90	110	Sonoma	70	70	70
Marin	#	95	100	Stanislaus	125	110	125
Mendocino	----	50	----	Sutter	90	100	100
Merced	100	100	100	Tehama	#	#	#
Modoc	#	#	#	Tulare	100	100	100
Monterey	#	50	50	Ventura	#	—	#
Napa	----	----	35	Yolo	80	80	80
Nevada	#	90	90	Yuba	100	100	100

Figures in table indicate condition of crop in per cent, on the basis of 100 as normal.
— Horticultural commissioner has insufficient information for a report.
Not grown commercially.

THE MONTHLY BULLETIN

CALIFORNIA STATE COMMISSION OF HORTICULTURE.

DEVOTED TO HORTICULTURE IN ITS BROADEST SENSE, WITH SPECIAL REFERENCE TO PLANT DISEASES, INSECT PESTS, AND THEIR CONTROL.

Sent free to all citizens of the State of California. Offered in exchange for bulletins of the Federal Government and experiment stations, entomological and mycological journals, agricultural and horticultural papers, botanical and other publications of a similar nature.

Entered as second class matter December 29, 1911, at the post office at Sacramento, California, under the act of June 6, 1900.

Napa Convention.—The Forty-ninth Annual State Fruit Growers' Convention, will be held on the 15th, 16th, and 17th of November. On the 13th and 14th—the two days preceding—the regular convention of the State Association of County Horticultural Commissioners will meet.

It is expected that most of the time of the convention will be given over to the discussion of marketing and allied topics. Contemplated horticultural legislation will also be discussed fully, and a report will be made by a large committee of prominent fruit growers, shippers, nurserymen and others, who have been giving this matter the most careful attention.

A special feature of the convention will be an extensive exhibit of farm tractors, tools, spray machinery, etc. Twenty-five acres of land have been secured for tractor demonstration purposes, and it is expected that the leading makes of farm tractors will be on exhibition. An effort is being made to secure a Henry Ford tractor which is at present in an experimental stage.

An important feature will be a basket picnic under the direction of the County Farm Bureau. This will take place at noon during one day of the convention, and will be attended by farmers and their invited guests from all parts of the county.

County Horticultural Commissioner Fox, of Napa, is working hard to make the convention the best that has ever been held in the state, and it seems probable that his efforts will be rewarded.—G. P. W.

Co-operation Between State and County Officials.—In connection with the State inspection of apples under the Standardization Act of 1915, and the inspection of potatoes under the Certified Seed Potato Act of the same year, there is need for the closest co-operation with the county horticultural commissioners and their inspectors, and

all apples or potatoes which pass state inspection it is expected will be of such a high grade that inspection by county officials will not be necessary. For example, apples being shipped into the markets of San Francisco, Los Angeles or San Diego, which bear on the boxes a state standard label indicating that they have been packed according to the high standards of the act, should be exempt from further inspection. It is doubtful if the exceedingly careful grading and the high standard that is being compelled under the direction of the state inspectors at Watsonville, is being maintained in many of the sections of this state or elsewhere, and recognition of the state label, as something that bears testimony to a splendid class of goods within the box is something that is expected of the county horticultural commissioners, and that their co-operation in this respect will be given is not doubted.

In the case of certified seed potatoes going into any county there should be the same exemption from further inspection. This commission has hired the best potato expert that it is possible to find in the state to pass upon certified seed, and nothing of a dangerous character will be certified. There will, of course, be certified seed that will need treatment with corrosive sublimate before planting, as a small amount of Rhizoctonia, scab, or Fusarium does not prevent certification. So certification of seed will not necessarily mean that the seed need not be treated, but it will mean much more than that. It will mean that the variety is pure, and that the inherent tendency to bear a big crop as well as a good crop is present in the seed. Scab, Rhizoctonia and Fusarium, to a certain extent, can be controlled by seed treatment, but no treatment can be given which will eliminate a poor bearing tendency and a mixture of varieties, or a poor strain of a variety. Hence, the important thing is not, after all, to be able to secure seed that is absolutely free from controllable diseases, but to be able to secure seed that possesses vitality and purity. The presence of these qualities can be determined only in the field while the potatoes are growing and when they are being dug, and not when sacked or stored in the cellar after digging. The care with which certified seed is inspected and handled by a state inspector, should exempt it from further inspection in the counties, and, again, the co-operation of the county horticultural commissioners is solicited.—G. P. W.

Mottle-Leaf.—"Mottle-leaf of Citrus Trees in Relation to Soil Conditions" is the title of an article by Lyman J. Briggs, C. A. Jensen and J. W. McLane, of the United States Department of Agriculture, appearing in the Journal of Agricultural Research, Vol. VI, No. 19. This article is summarized as follows:

"Mottle-leaf of citrus trees is characterized by the disappearance of chlorophyll from parts of the leaf, the portions farthest removed from the midrib and larger veins being first affected. As the disturbance progresses, the yellowish spots increase in size until the only remaining chlorophyll is confined to narrow areas along the midrib and the larger veins. The advanced stages are accompanied by a marked decrease in the size, quality, and yield of fruit. No organism has yet been proved to be casually associated with mottle-leaf, but the citrus-root nematode has been found by Thomas to be widely distributed in mottled districts.

Mottle-leaf is found in most citrus fruit sections of California, but is more prevalent in some districts than in others. All the citrus fruits grown in California

are affected, including the Washington Navel, Thompson Improved Navel, and Valencia orange, grapefruit, tangerine and lemon.

The conclusions of the present paper are based upon a field and laboratory study of 130 orange groves and 45 lemon groves, located mainly in Riverside and San Bernardino counties, California. The percentage of mottled leaves was determined by examining 10 to 12 typical trees in each grove. A soil sample 3 feet in depth was taken near each tree, each foot sample being kept separately. These samples were analyzed for humus, organic carbon, mineral carbonates, and total nitrogen.

During the earlier stages of mottling no serious reduction in yield was observed. The fruit yield was apparently not seriously reduced on either orange or lemon trees which had about 20 per cent of their leaves mottled. Sour-orange stock was found to induce more severe mottling in orange trees than sweet orange stock, other conditions being the same. A mixed grove of Washington Navel and Valencia oranges showed no difference in the amount of mottling of these two varieties.

Badly-mottled orange trees cut back and rebudded on the stumps produce badly-mottled new top growth; and unless the soil treatment of such groves is changed, the mottling persists.

There was no noticeable difference in the amount of leaf mottling in groves on different soil types, other conditions being the same.

Orchards fertilized with organic substances, such as stable manure or cover crops, plowed under, usually showed less mottling that groves supplied principally with commercial fertilizers. Groves which for some years had received only the "complete" fertilizers in general use in the areas studied were badly mottled in all cases, so far as observed in these studies. This was also the case where sodium nitrate was used alone or as the principal fertilizer for some years.

The results of the soil analyses show in the case of oranges a marked inverse correlation between the humus content of the soil and the percentage of mottling, the latter tending to diminish as the humus content increases. An impartial statistical study of the data from the individual orange groves shows that approximately one-half the mottling can be accounted for by the low humus content of the soil.

The humus content of the lemon soils studied is much below that of most of the orange soils, averaging less than 0.1 per cent. This amount of humus is apparently too low to produce a normal foliage growth, all of the lemon groves being badly mottled.

No correlation was found between the mineral carbonates of the soil and the mottling of orange trees. In lemons the mottling decreased slightly as the mineral carbonates increased, but the correlation is low. The lime content of nearly all the citrus soils studied, is low, and the effect of heavy applications of lime can only be determined by suitably controlled field experiments. The present study indicates that the application of lime would be more likely to benefit lemon trees than orange trees.

The percentage of mottled leaves on orange trees is definitely correlated with the increase of the ratio of organic carbon to humus, indicating the importance of the organic matter in the soil being well decomposed.

No relation was found between the percentage of leaves mottled and the total nitrogen content of the soil in either the orange groves or the lemon groves studied.

The principal conclusion of this investigation is that the mottling of orange trees in the areas studied is definitely correlated with the low humus content of the soil, the mottling diminishing as the humus content increases. A study of the data by statistical methods shows that approximately one-half of the mottling can be accounted for on this basis. The incorporation of organic matter with the soil in such a manner as to be accessible to the roots during its decomposition is indicated as a promising treatment for mottle-leaf.

Horticultural Laws.—The movement to amend some of the existing horticultural statutes, thereby strengthening them in places where they have been found weak, is commendable, and will no doubt receive the support of all wide-awake horticulturists, fruit growers, nurserymen

and other interested parties. It has been necessary for the county horticultural commissioners to operate under county ordinances because of limitations of the law creating their office. Such ordinances, while they have served as a means towards a good end, have made much trouble; uniformity of inspection throughout the state has been impossible and much difficulty has resulted because of a multiplicity of ordinances. The contemplated change in the county horticultural commissioner law, which will give commissioners all powers now carried by county ordinances, and which will make such powers uniform in every county of the state, is a step in the right direction.

The state of Calfornia is blessed with some excellent horticultural laws, and there is probably little need of more laws, but of strengthening and co-ordinating those that already exist. Certain weaknesses in the standardization laws should be eliminated, and, if possible, regulations governing standardization of all deciduous fruits, at least, should be included in one law. This should mean the co-ordination of the Apple Act with the Deciduous Fruit Standardization Act. Inspection under both acts has proved of much value, and the standards are unquestionably much higher than ever before. The fund created by the sale of standard stamps under the Apple Act has been ample to cover the cost of inspection, and the system has worked perfectly. The idea of using the state label as a guarantee of the contents of a box of fruit is good, and while it now applies only to apples, it should be extended to all fruits.

The most careful consideration of all the details of our horticultural statutes, by those who have tested them practically and who have given them the closest study and attention, is necessary, and it is hoped that any future legislation will be aimed toward greater uniformity as well as efficiency.—G. P. W.

Progress of the Sicilian Mealybug Parasite.—In the November (1915) number of the Monthly Bulletin the writer recorded the successful breeding, under natural conditions in the orchard, of *Paraleptomastix abnormis,* the Sicilian mealybug parasite. The observations recorded at that time covered the period known as the summer months and the colonies examined were planted during the spring of the same season. The crucial test of an introduced species' ability to establish itself in new surroundings usually takes place during the winter when all insect life is in a more or less dormant state. It is very gratifying to be able to record now, nearly a year since the publication of the above mentioned notes, that on a trip of inspection of the parasite colonies in the South during August, Paraleptomastix was found breeding abundantly in practically every orchard where they had been liberated the summer before. All had passed the winter successfully and many of the colonies had survived fumigation and spraying as well. One colony, that in the Shaw orchard at San Diego, had withstood two fumigations, one only two weeks previous to the recent tour of inspection, and yet the parasite occurred commonly in the mealybug-infested trees.

There is no longer any doubt as to the ability of this species to live and thrive in California, and it is certain to become a valuable aid in the control of the citrus mealybug. Time is necessary for a new parasite to become sufficiently abundant to be of practical value in the control

of pests, due to the fact that any surplus of parasites is taken up in the spread of the species. Once the insect is thoroughly distributed over the region it is to inhabit, it will increase rapidly in abundance of individuals at any particular point, and then, and not until then, will it become of practical importance. The period of time necessary to wait can be greatly shortened by artificially spreading the parasite and this work the Insectary is engaged in at the present time.—H. S. S.

Recent Ladybird Introductions.—During the past two months two species of ladybirds, one a scale feeder and one an aphis feeder, have been colonized in California. These were received from Mr. Clausen, assistant superintendent of the Insectary, who is at present in the Orient, searching for beneficial insects. Both species were collected in Japan. The scale-feeding ladybird is *Chilocorus similis*, the same species which was introduced several years ago by the United States Department of Agriculture, but which apparently failed to become established. Its principal food is said to be the San Jose scale, but it feeds upon practically all Coccids, preferring however the armored scales or Diaspinæ. The aphis feeder has been determined as *Ptychanatis oxyridis* and is an extremely variable species. It is of large size and is generally black with a large reddish spot on each wing-cover, although it is frequently yellowish with numerous black spots. It feeds voraciously on most aphids and should be of value in their control. Both ladybirds were colonized in Capitol Park, Sacramento.—H. S. S.

QUARANTINE DIVISION.

FINIS RATIONEM EXCUSAT.

Report for the Month of July, 1916.

By Frederick Maskew.

The planting of a commercial orchard, a vineyard, or even an ornamental tree in California, is an undertaking freighted with many consequences, and every endeavor should be made to determine the nature and condition of all material imported into the state for such purposes before a permanent establishment is granted. In considering this problem the fact should not be lost sight of that when a person plants an orchard he is not performing some act of a transient nature, but making a permanent investment that is expected to endure and yield a profit the length of his natural lifetime; further, the results of such a planting are destined to concern in a marked manner, not alone himself and his immediate neighbors, but in a measure the entire community. The planter is assuming, knowingly or not, the burden of care and attention demanded by a large number of living, growing organisms for an indefinite period, and it is well both for himself and the community to determine at this time that each individual unit of the company is clean and sound, and physically fit to endure to the end. Negligence or failure upon his part to take such precautions may not alone prove disastrous to the success of his personal venture, but evil conditions, if introduced, will eventually affect the revenues of his neighbors, and ultimately those of the entire industry.

It was with a clear conception of this phase of the situation—the problem of community protection from the calamitous results sure to follow the carelessness, ignorance or indifference on the part of the individual planter—that public sentiment expressed itself in concrete form through an act of the legislature providing for control on arrival, and furnishing competent official inspection in every instance at point of delivery, of all imports of plants and plant products as recorded each month in this report.

SAN FRANCISCO STATION.

Steamship and baggage inspection:

Ships inspected	76
Passengers arriving from fruit fly ports	3,149

Horticultural imports:

	Parcels
Passed as free from pests	47,716
Fumigated	2,605
Refused admittance	76
Contraband destroyed	8
Total parcels horticultural imports for the month	50,405

Pests Intercepted.

From Central America:

Pseudococcus sp. and *Aspidiotus cyanophylli* on bananas.

From China:

Larvæ of weevil in sweet potatoes.
Lepidopterous larvæ in walnuts.
Pseudococcus sp., and red spiders on Litchi trees.

From Honolulu:

Asterolecanium sp., *Pseudococcus* sp., *Icerya* sp., and larvæ of *Thrips* sp. on unknown plants.
Larvæ of weevil in Tamarind seeds.
Diaspis bromeliæ and *Pseudococcus bromeliæ* on pineapples.
Coccus longulus on betel leaves.

From Japan:

Fungus on oranges.

From Mexico:

Weevils in avocado seeds.
Lepidosaphes gloverii on limes.

From New Jersey:

Cerataphis sp., and *Aspidiotus* sp., on orchids.

From New York:

Diaspis boisduvalii, Isosoma orchidearum and Lepidopterous pupæ on orchids.

From Ohio:

Dialeurodes citri on lemon trees.

From Papeete:

Morganella maskelli on oranges.
Dipterous larvæ in cocoanut buds.

From Pennsylvania:

Pseudococcus sp., *Chrysomphalus aonidum, Aspidiotus* sp., and *Cerataphis lataniæ* on palms.

LOS ANGELES STATION.

Ships inspected	28

Horticultural imports:

	Parcels
Passed as free from pests	41,282
Fumigated	16
Refused admittance	6
Contraband destroyed	6
Total parcels horticultural imports for the month	41,310

Pests Intercepted.

From Brazil:

Diaspis boisduvalii on orchids.

From Central America:

Pseudococcus sp., *Aspidiotus cyanophylli, Saissetia hemisphærica, Aspidiotus cydoniæ* and *Chrysomphalus scutiformis* on bananas.

From Colombia:

Cattleya fly and *Diaspis boisduvalii* on orchids.

From Colorado:

Pseudococcus sp. on begonias.

From Mexico:

Calandra sp. on Tamarinds.

From Pennsylvania:

Eucalymnatus tessellatus, Aspidiotus cyanophylli and *Chrysomphalus aonidum* on Robelinia palms.
Pseudococcus sp., *Coccus longulus* and unidentified Coccid on Crotons.
Pseudococcus sp. on Dieffenbachias.
Unidentified Coccid on Aralias.
Cerataphis lataniæ, Aspidiotus lataniæ, Chrysomphalus aonidum and *Chrysomphalus aurantii* on Kentia palms.

From Texas:

Cladosporium carpophilum on Peaches.

From Venezuela:

Cattleya fly and *Diaspis boisduvalii* on Orchids.

SAN DIEGO STATION.

Steamship and baggage inspection:

Ships inspected	34
Fish boats inspected	89
Passengers arriving from fruit fly ports	721

Horticultural imports:

	Parcels
Passed as free from pests	1,792
Fumigated	1
Refused admittance	2
Contraband destroyed	8
Total parcels horticultural imports for the month	1,803

Pests Intercepted.

From Japan:

Unidentified insect mass on branch of arbor vitæ.

From Mexico:

Unidentified Lepidopterous or Coleopterous larva in plum.

EUREKA STATION.

Steamship and baggage inspection:

Ships inspected	6

Horticultural imports:

	Parcels
Passed as free from pests	8

SANTA BARBARA STATION.

(No report.)

O

COUNTIES HAVING HORTICULTURAL COMMISSIONERS, WITH THE RESPECTIVE CITIES IN WHICH THE COMMISSIONERS RESIDE.

County	City
Alameda	Oakland
Butte	Oroville
Colusa	Colusa
Contra Costa	Martinez
El Dorado	Placerville
Fresno	Fresno
Glenn	Willows
Humboldt	Eureka
Imperial	El Centro
Inyo	Bishop
Kern	Bakersfield
Kings	Hanford
Lake	Kelseyville
Lassen	Susanville
Los Angeles	Los Angeles
Madera	Madera
Mendocino	Ukiah
Merced	Merced
Modoc	Alturas
Monterey	Aromas
Napa	Napa
Nevada	Grass Valley

County	City
Orange	Santa Ana
Placer	Bowman
Riverside	Riverside
Sacramento	Sacramento
San Benito	Hollister
San Bernardino	San Bernardino
San Diego	San Diego
San Joaquin	Stockton
San Mateo	Redwood City
Santa Barbara	Santa Barbara
Santa Clara	San Jose
Santa Cruz	Watsonville
Shasta	Anderson
Siskiyou	Yreka
Sonoma	Santa Rosa
Stanislaus	Modesto
Sutter	Yuba City
Tehama	Red Bluff
Tulare	Visalia
Ventura	Ventura
Yolo	Woodland
Yuba	Marysville

ALBERT JOHN COOK.

The announcement of the death of Dr. A. J. Cook, on September 29th, while not unexpected, came as a shock to his host of California friends, and it is with the greatest reverence and respect for the man who so faithfully and conscientiously conducted the affairs of the office of State Commissioner of Horticulture, that we pay this little tribute to his memory.

We who have been so closely associated with Dr. Cook in the daily work of the office have lost a true friend, and in his departure from this life there has gone from among us a great potential force which has ever directed us toward renewed activities and greater service. His life was devoted to work, and few men had a greater capacity for work than he. The sluggard got no sympathy from him, but the man who made an earnest, honest effort could always be assured of a helping hand. Dr. Cook was a staunch advocate of a clean, pure life, and for years young men in the college classroom were made better because of his influence over them. Today there are scores of these men in prominent positions which they are filling creditably, who are always eager to testify to the benefits of the personal touch of the man who, as college professor, took an interest in them, and who devoted his tremendous energy not only toward impressing upon their minds the lessons from books, but also the greater lessons of morality and service.

As State Commissioner of Horticulture, Dr. Cook has done a work for which he will long be remembered. No matter what difficulties arose during his term of office he was always optimistic. He undertook each task with energy and enthusiasm, and the record of his accomplishments in state-wide service places his name among those of California's honored dead, who have made worthy contributions toward the advancement of the great horticultural industry.

Dr. Cook was born in Owosso, Michigan, on August 30, 1842. He took his bachelor of science degree at the Michigan Agricultural College in 1862, and the degree of master of science in 1865 at the same institution. He studied at Harvard during the years 1867 and 1868. He was professor of zoology and entomology in the Michigan Agricultural College from 1869 to 1893. He was curator of the General Museum from 1875 to 1893. From 1888 to 1891 Dr. Cook was entomologist at the experiment station, and in 1893 he moved to California, taking the position as professor of biology at Pomona College, which position he left in 1911 to become State Commissioner of Horticulture. From 1895 to 1905 he was conductor of the university of extension work in agriculture. He was the author of the Manual of the Apiary, Injurious Insects of Michigan, Silo and Silage, Maple Sugar and the Sugar Bush, Birds of Michigan, and California Citrus Fruits, 1913.

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THE MONTHLY BULLETIN.

CALIFORNIA STATE COMMISSION OF HORTICULTURE

Vol. V. October, 1916. No. 10

LOGANBERRY CULTURE IN THE NORTHWEST.

By C. L. Lewis, Chief, Division of Horticulture, Oregon Agricultural College, *Corvallis, Oregon.*

No phase of northwest horticulture has attracted more attention during the past few years than that of loganberry growing. There has been a wonderful development during this period. Thousands of acres have been planted and the industry now seems to be pretty well established.

About four or five years ago there was a considerable slump in loganberry growing. At that time the yield had reached considerable proportions and there was no market for the product. They would not ship very far, canning was unsuccessful, no one had attempted the evaporation of the fruit and the juices had not been tried out. Consequently the market was very limited and was easily overstocked. The use of the berries through many new channels the last few years has greatly stimulated the planting and development of the industry. However, during the past year there has been very little planting owing to the fact that many people feared the industry was being overdone.

CULTURAL RANGE.

The principal cultural range in the Pacific Northwest runs from the Cascade Mountains to the ocean, including a long strip of land in western Washington and western Oregon. The loganberry will thrive where the atmospheric conditions are not too dry, where the heat is not too excessive and where very cold winter temperatures do not exist. Unless these conditions can be complied with, loganberry culture is not very profitable.

SITES AND SOILS.

The berry is not particular as to the soil in which it grows. It grows from the alluvial river bottoms to the red clay hills. It only demands a soil of fair depth and of good drainage. However, it yields the best in rich mellow loams.

PROPAGATION.

The plants are very easily propagated by tips. There is a belief by some men that while the plants can be propagated by cuttings that these plants propagated in this way are not as long lived as those which come from good rooted tips.

TILLAGE.

The tillage is very much the same as that which is adapted to other small fruits. However, the larger growers are beginning to feel that there is danger in too much disking, and if disks are used in the patches.

they must be used sparingly and very carefully. One of the largest growers in the state plows the ground toward the plants in the fall and plows it away in the spring. He uses a gang plow and by going down the row twice he can turn all the soil. He then follows with light harrowing until the ground is level.

COVER CROPS.

A few of the growers are beginning to use cover crops. The main objection to using cover crops, however, is that they become quite rank in the spring and a little hard to handle. However, if they are plowed under before they become too high, and if the proper precautions are taken, they may be handled quite nicely.

FERTILIZERS.

At the present date very few fertilizers have been used in the loganberry patches. We are conducting experiments at the Oregon Experiment Station, and have been conducting these experiments on the use of fertilizers in loganberry production. We will give a report on the same in the very near future.

IRRIGATION.

At the present time very few loganberry patches have been irrigated as the loganberry is grown in a country where irrigation is rarely practiced. Most irrigated districts have too severe winters and also are subjected to considerable heat in the summer—more than the loganberry desires. However, in some of the irrigated countries, loganberries are being grown to a limited extent.

PRUNING.

There is considerable difference of opinion as to the best method of pruning and training. The majority of the growers are coming to believe, however, that it is a good practice to cut out the fruiting canes just as soon as the fruit has borne. We are urging this very strongly at the experiment station because anthracnose, which is the worst disease that attacks this plant, can be somewhat controlled by cutting out the old canes and burning them promptly as soon as the fruit is harvested.

The question as to the proper time of training up the young plants is also open to difference of opinion. Most growers practice kicking in the young shoots close to the vine during the early summer. They sometimes put down little stakes every few feet in order to keep the plants away from the cultivators and out of the way of the feet of the pickers. Some growers practice, as soon as the old canes are taken out in midsummer, putting the new shoots up on the wires and interwinding them and spreading them at different times during the summer. Other growers prefer to wait until fall and do the work at that time, while still others maintain that the spring is the best time to put up the new plants, believing that if they are left down all winter they are protected against excessive cold, should it occur. Some growers, however, contend that if this is done, the yield is not so good, while others maintain that the yield is better. We are conducting experiments, however, to prove such points. Some growers advocate spreading the vines out

fan-shaped; others believe in having them wound around in rather thick clusters, claiming that the plants are stronger this way; that there is more shade; that they thrive better in the shade than they do in the sun. Some growers keep thinning out the weaker shoots and cut back the fruiting canes that will be left to about eight or ten feet in length, claiming that unless this is done the berries are small and not as good results are secured as can be secured through good pruning.

PLANTING DISTANCE.

The rows are generally put about eight feet apart and the plants eight to twelve feet apart in the row, according to the soil.

AGE OF BEARING.

The berries will give some fruit by the third year, and succeeding years bear very heavily.

DURATION OF PLANTATION.

We have plantations now in the state of Oregon that are fifteen years old and are still very fruitful.

YIELDS AND PRICES.

The yields vary somewhat according to soil and care. It ranges from three to six tons, from four and one-half to five tons being a very fair average.

The prices range from two and a half to three and a half cents a pound. Most of the contracts this year are in the neighborhood of three cents. At this price there is a very good profit. In fact, loganberry growers have been among the most prosperous fruit men in the entire Pacific coast during the past three years.

INSECTS AND DISEASES.

The principal disease which one has to contend with is the cane anthracnose. This is similar to the anthracnose that attacks the raspberries. To control this we advocate: first, the cutting out of the old canes just as soon as the crop has been harvested; second, if the attack is very bad, spray with Burgundy mixture soon after the fruit has set; after the fruit has been picked, give a summer Bordeaux spray of 5-5-50 strength.

The principal insect we have to watch out for is the cane borer.

TIME OF HARVESTING.

The time of harvesting and methods employed depend upon what you are going to do with the fruit. We recently conducted some investigations at the experiment station which are being published now in the form of a bulletin.

If the berries are to be evaporated, they should be picked when they are firm, yet ripe. Soft berries are not desirable for such purposes. The fruit should also be picked, preferably, by 10 o'clock in the morning. It should not be picked in the afternoon. It should be rushed to shady sheds, or into a building soon after it has been picked. The berry is very soft and melts down very rapidly during warm summer

days, and if allowed to melt, it runs, and caramels and burns, and does not make a very good evaporated product.

If the berries are to be used for juice purposes they should be allowed to become ripe; it was found by chemical tests that if the berries were allowed to become very ripe the sugar content was very materially increased and the acid content was very materially reduced. Where large quantities of juice are to be manufactured it is unwise to allow the berries to become extremely ripe, since in that condition they easily mould and ferment.

Where berries are being picked for the cannery they should be allowed to get ripe and the pickers can work all day. The berries must be handled very carefully or they will arrive at the cannery in a very poor condition.

Where berries are to be shipped any distance to cannery or evaporator, some of the growers employ cattle cars for such purposes and ship the berries at night. These open cattle cars allow for greater ventilation than is possible to obtain in box cars and save the expense required if refrigerator cars are used.

MARKETING.

Up to five years ago the berries had to be marketed in the fresh state in our local city markets and were generally a drug on the market; the prices received were far from satisfactory; but with the advent of canneries, the evaporation and juice manufacture, most of the berries are being turned into these channels and very few are being sent to the markets in the fresh condition. However, loganberries have been shipped from local coast points to middle western points in fairly good shape. Some have been sent to the Atlantic seaboard in good condition, but the cost is so great that the price becomes prohibitive.

In order that the loganberry may become properly advertised; and the berry's products may be properly standardized; and that a good market may be found for the output, the Oregon Loganberry Juice Manufacturers Association has recently been organized, and is now at work. In all probability this association will do a great deal of good in bringing this splendid product before the American people. Single firms are spending themselves in advertising, one firm alone on July 29th, using a full page adv. in the Saturday Evening Post.

EVAPORATING.

During the past two or three years much interest has been shown in the evaporated product. There is a limited demand for dried berries at a fair price, but a large sum of money is required to introduce them to the trade. The berries should be evaporated in a building. While they can be dried in the sun, the sun-dried product is not as attractive as that evaporated by artificial heat.

If the tunnels of the dry kiln are properly constructed and not allowed to become too long, and if the heat is moved rapidly over the fruit, the berries can be dried in from 12 to 16 hours. If this is done, however, it will be necessary to start the temperature at about 130° F. and finish at about 160° F. Many of the growers start at from 80° F. to 100° F. and require sometimes nearly 40 hours to dry the fruit. This we feel is a great mistake, and that it is impossible to turn out as

good a product by such methods. After the berries are dried, they should be sweated in a room until they are in uniform condition. They should also, during the night time, keep away any light, as there is a night-flying moth which will lay eggs in the fruit and cause it to become wormy.

The fruit is put in sacks, boxes or cartons, according to the demand.

MANUFACTURING THE JUICE.

This year there is a great deal of interest shown in the juice. We find by test that the berry contains at least 75 per cent juice which can be extracted by simple means. Presses, sugar, carbonizers and bottling machines are needed for this juice. It can be prepared in many ways, heated or unheated, and with varying amounts of sugar. A circular letter on the subject can be obtained from the Oregon Agricultural College. Nearly every one who samples loganberry juice states that it is preferable to grape juice. It is certainly attractive in appearance and has a splendid acid taste which leaves a pleasant after effect in the mouth. I can see no reason why this beverage should not become fully as popular as the famous Welch's grape juice.

Some of the berries are being shipped East, put in paraffin-lined barrels, mixed with sugar and shipped in refrigerator cars. There is a certain demand which has been satisfied with the product in this form.

CANNING.

The canneries are taking the product in ever increasing quantities. In the early years they found that the acid ate the tin very badly, but when they used the enameled tin they overcame this difficulty. In some markets the loganberry has not yet met with a very hearty reception in cans. This is due to the fact that some of the cannerymen have filled the cans nearly full of the fruit and since the berry has a solid core there is very little air space left for the juice and sirup to fill in the can. Also the sirup which they have been using was of low sugar content, and the berries consequently were very tart—so tart, in fact, as to injure the sale. This year the cannerymen of the Northwest have taken steps to use a heavy sirup and are not to fill the cans quite so full of fruit. This will undoubtedly turn out a much more attractive product.

USE OF PRODUCTS.

The berry has a great many uses. As an evaporated product, it can be shipped all over the world, can be used for sauces, pies, etc. It makes a splendid jell and a very rich jam. Its juice is excellent for beverage purposes. It makes a very acceptable wine, a good vinegar, and is unexcelled in flavorings, for ice creams, sherbets, etc.

All in all, we feel that the loganberry is going to become one of the greatest horticultural assets of the Pacific Northwest, and it is only a question of a very short time before this fruit will command a leading position. It has been estimated that Oregon alone this year will manufacture 2,000,000 gallons of juice, and we are predicting that in the near future $2,000,000 worth of loganberry products will be shipped annually from Oregon. Salem alone has invested half a million dollars in juice plants.

THE PERSIMMON IN CALIFORNIA.

By SUMITO FUJII, University of California.

The Japanese persimmon, one of the most delicious commercial fruits, has met with many obstacles and difficulties on its way into the horticultural industry of the United States. For nearly half a century after its first introduction into this country the persimmon not only did not receive due appreciation, but in many instances rather created a prejudice against itself among the general public. This was due of course to the lack of knowledge about this fruit on the part of the introducers and growers. The persimmon is very attractive in appearance, with its bright orange or tomato red color. It is very delicious and is liked by every one if eaten properly. It is much higher in nutritive value than any other fruit of like use, such as peaches, pears, apples, oranges, plums, etc. It is a very good keeper if handled correctly, grows very thriftly and bears prolifically if proper varieties are chosen and the trees well cared for. In order to appreciate this excellent fruit to its fullest extent the grower should exercise great

FIG. 121.—The Jiro persimmon. (Original.)

care in the selection of varieties, in planting and growing the trees, and in handling the crop and supplying the consuming public with fruit in proper condition. The failure in the past was chiefly due to the lack of knowledge and proper care among the introducers and growers.

During the last ten years or so the general public has been educated to a certain extent and growers have become more interested in planting persimmons in this state. This fact, together with the rapidly increasing demand for persimmons in eastern markets, promises greater prosperity for persimmon growers in the future. However, the writer, who has been studying this fruit for several years, both in this country and in Japan, and who made an extensive trip last fall through the persimmon districts of Japan, studying the varieties, has been greatly impressed with the lack of knowledge still existing among growers regarding varieties. Great emphasis should be placed on the fact that the selection of right varieties is the corner stone in the industry of fruit growing. Unfortunately enough, the early importations of persimmon trees which became the main source of the knowledge in this

country, seem to have been made through nurseries which could only furnish local varieties under local names. Accordingly, many varieties mentioned in the early reports are of inferior quality, and not known even in Japan in commercial planting and some of them are given entirely wrong names. The difficulty of entangled nomenclature has been greatly increased by recent importations of grafted trees through nurseries, which under the present conditions can never guarantee them for the variety. Considerable money is being expended every year on these unreliable trees and worthless varieties.

Of those grown in this state there are among the astringent varieties, the so-called Hachiya, Tanenashi, Yemon and some others of minor importance, and among the sweet varieties, Hyakume and Gosho. Fuyu has also been recently imported. The commercial planting in California is still based largely on astringent varieties, simply on account of lack of knowledge regarding the merit of the best sweet varieties. Astringent varieties should undergo some artificial process, which greatly impairs the keeping quality, or should be stored until

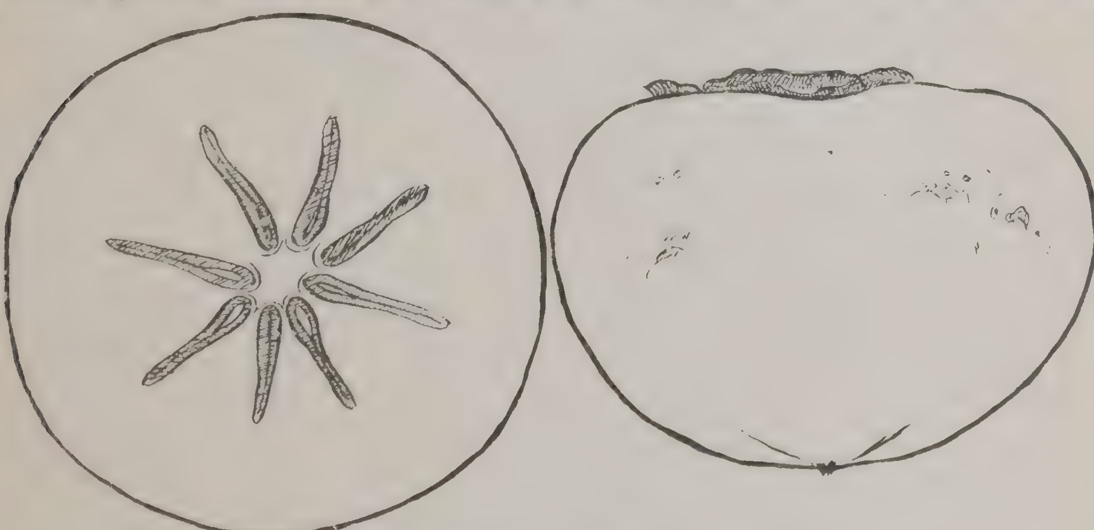

Fig. 122—The Hanagosho persimmon. (Original.)

soft in order to be fit for use; while some of the best sweet varieties may be kept after they are picked for three to four months if properly handled, and then shipped thousands of miles and arrive in good condition and ready for use. Moreover they are brighter in color and far better in flavor than astringent varieties, at the same time being thrifty growers and heavy bearers. Why should not, then, choice sweet varieties be the standard of commercial planting?

Considering the quality of the fruit, thriftiness and bearing habit of the tree, the writer is inclined to recommend the following varieties for commercial planting: Among sweet varieties, Jiro, Hanagosho, Fuyu, Tenjingosho, and possibly Gosho, Shogatsu, and a few others. Among astringent series, Yokono, Hachiya (Dojo-Hachiyo), Fuji, and probably Yemon, Saijo, Giombo, Mino, and a few others. Descriptions of only the very best may be given here. The name Gosho stands for a variety which originated at the village of Gosho. Thus the ending attached to persimmon names may indicate their origin and type. Gosho is roughly equivalent to the term "pippin" in American apple nomenclature.

Jiro (Name of a man). See Fig. 121.

Fruit: Size large, about two-thirds pound; shape oblate, the transverse cross section strictly quadrangular, the apex and the calyx slightly depressed; four shallow furrows appear on the side; color, deep orange to vermilion, adding deep red when full ripe; flesh light yellow with very few dark specks, tender, very sweet and juicy, excellent quality; skin rather tough which insures very good keeping and shipping quality; seeds few or none. The tree is a very thrifty grower and very prolific, and undoubtedly this is one of the very best varieties.

Hanagosho (Flower-gosho). See Fig. 122.

Fruit: Size large; shape dull conical, the transverse cross section considerably quadrangular, apex flat, base wide with deep cavity, very plump; color deep orange to vermilion, adding deep red and lustrousness when full ripe, often with black russet or cracks around the apex;

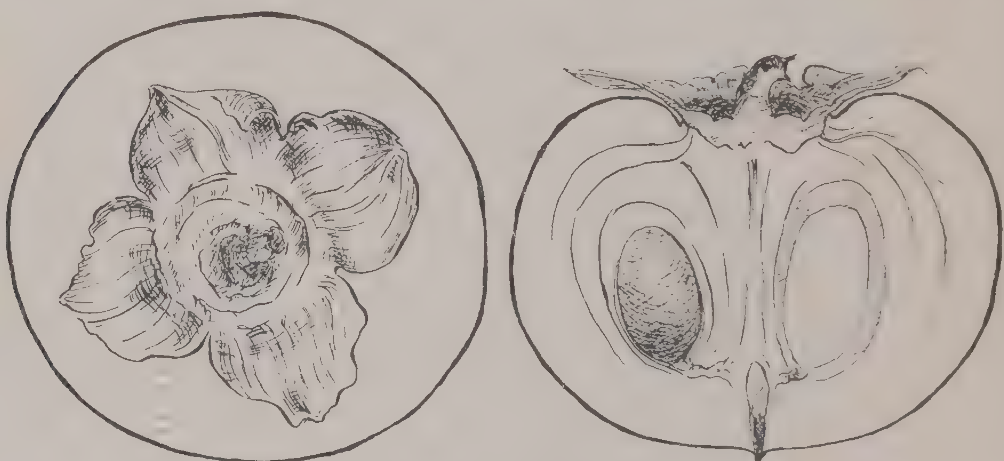

FIG. 123.—The Fuyu persimmon. (Original.)

flesh, deep orange, no dark specks at all, fine texture, very sweet, highly agreeable flavor, quality excellent; seeds few or none. The tree is a thrifty grower and prolific. The fruit ripens between October and November. It is a very good keeper and is one of the very best varieties.

Fuyu (Wealthy). See Fig. 123.

Fruit: Size large, one-half to two-thirds pound; shape oblate, roundish, plump, developing very smoothly, apex flat; color deep red and very beautiful when fully ripe; flesh with very few dark specks, tender, juicy and sweet, quality excellent; seeds few. The tree is very thrifty and prolific. One of the most promising varieties.

Tenjingosho (The God Tenjin's gosho). See Fig. 124.

Fruit: Large, about one-half pound; shape closely related to Fuyu but apex is much higher and slightly pointed, form rather a conical shape; color most beautiful deep tomato red; flesh light yellow with very few dark specks, juicy, tender and very sweet, quality very good; seeds few. The tree is a thrifty grower and is very promising.

Yokono (Name of village). An astringent variety. See Fig. 125.

Fruit: Size large, about two-thirds pound; shape rather quadrangular, apex slightly depressed with four prominent grooves running outward from it; color light to reddish orange and very lustrous; flesh light yellow with no dark dots, tender, very astringent; when processed, very sweet and juicy, quality excellent; usually seedless.

The tree is exceptionally thrifty and very prolific, bearing heavily every year. This is probably the best variety among astringent series.

Hachiya (The beekeeper). Also called Dojo-Hachiya. See Fig. 126.

Fruit: Size large, usually over one-half pound; shape oblong with well stretched shoulders and being rather quadrangular; apex slightly pointed; transverse cross section somewhat quadrangular, cavity none and calyx rather protruded; color rather light; flesh tender, fine. This

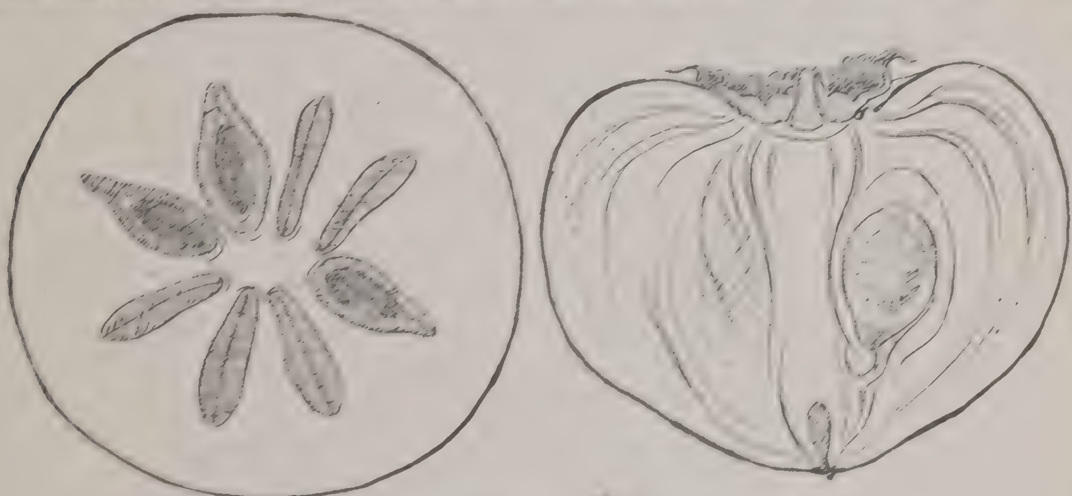

FIG. 124.—The Tenjingosho persimmon. (Original.)

is best suited for drying purposes as it loses very little volume when cured; seeds one or two, often none.

The tree is very thrifty and prolific and is one of the most highly recommended. Hachiya is very often confused with other varieties, especially with Mino and Fuji. Those so-called Hachiya in California are in most cases either Fuji or Mino.

Fuji (Name of the most beautiful mountain). See Fig. 127.

This is often confused with Hachiya and many nurseries sell this under the latter name.

Fruit: Size larger than Hachiya, usually two-thirds pound, and sometimes over one pound; shape oblong-conic, dropping off rather abruptly to a point, cavity deep; color yellowish orange, deeper toward the apex; often marked with dark spots and lines near the apex; flesh light orange in color, seedless in most cases, quality fairly good when dried, very sweet and juicy when soft ripe.

The tree is quite thrifty and erect grower and fairly prolific. Season November. This is also a very promising variety.

The greatest difficulty in obtaining right varieties lies in the fact, as many growers have already experienced, that trees imported through nurseries are unreliable. The writer's investigation of the reliability

of the variety furnished by the nurseryman resulted in great discouragement. Before the trees reach the exporter they usually go through the hands of men who have little knowledge of the variety. In many cases these trees are collected from local nurseries, where different names may be given to the same variety as well as different varieties grown under the same name. Thus Hachiya trees collected from three districts may very probably contain Mino, Fuji and Hachiya.

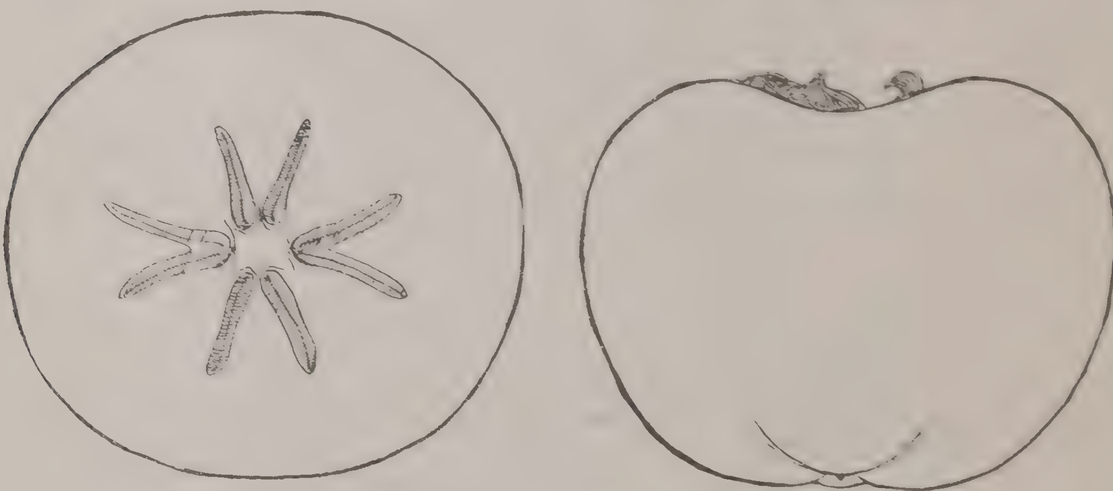

FIG. 125.—The Yokono persimmon. (Original.)

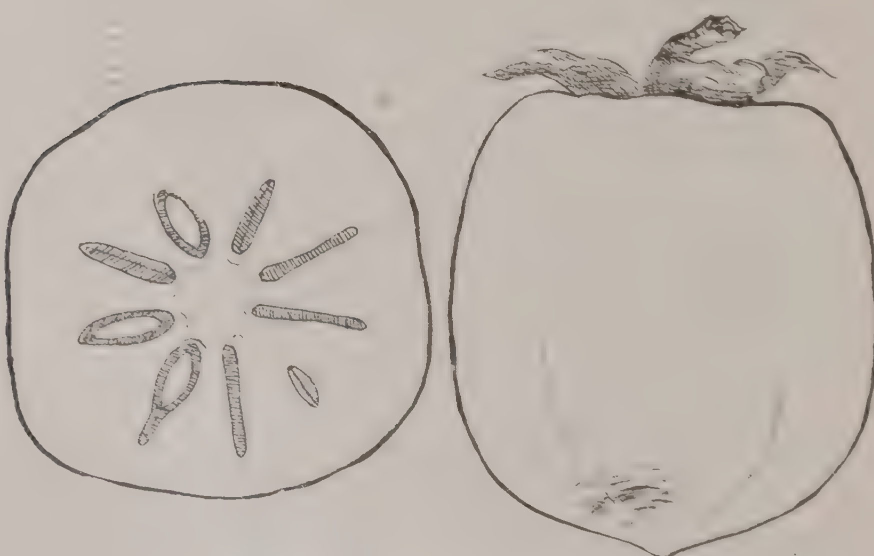

FIG. 126.—The Hachiya persimmon. (Original.)

Serious mistakes are occasionally made by careless nurserymen as in the case of the following example: The Fuyu became known very recently, and when first described as a superb variety the demand for the grafted trees increased so suddenly that the original tree could no longer furnish scions, and some nurserymen used scions from some

inferior variety of the same general type of fruit. Some of these defective trees of course reached the hands of other nurserymen, who, in turn, propagated from them under the name Fuyu. Satisfactory results can only be accomplished by a specialist who can go through

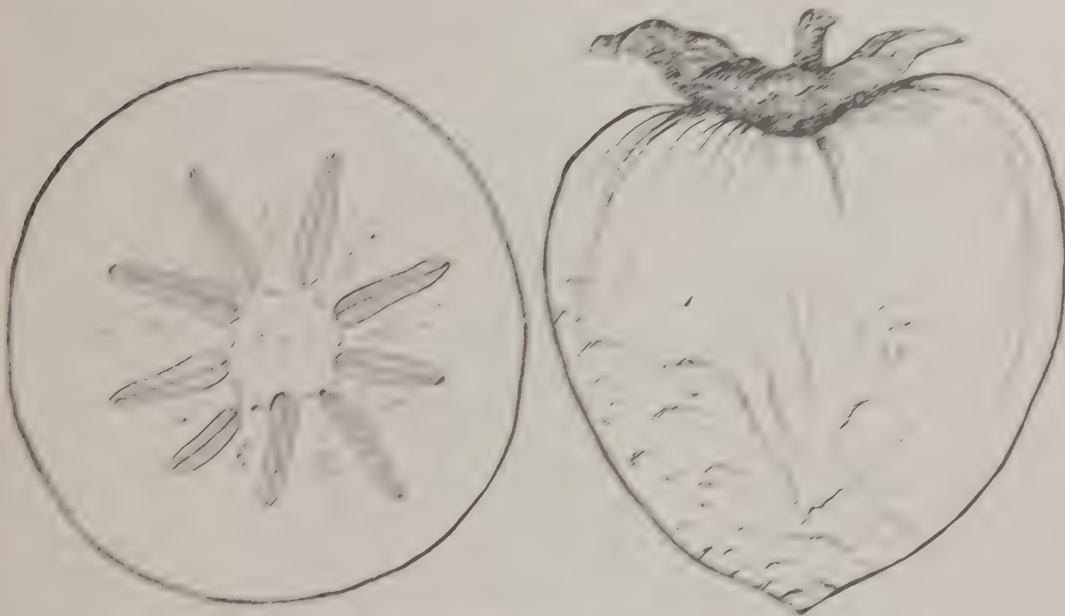

Fig. 127.—The Fuji persimmon. (Original.)

the local nurseries in persimmon districts and examine the trees from which the scions have been taken and thus select only right trees. This would be an exceedingly laborious task, yet it should be insisted upon by intelligent growers for the sake of the future prosperity of the persimmon industry.

SOME FIGURES ON THE COST OF BRINGING ORCHARDS INTO BEARING.

We have had a generous response to our request in a recent issue of The Monthly Bulletin for data on the cost of bringing orchards into bearing and so we are presenting these figures for the benefit of those who are contemplating the planting of an orchard. To the growers who have submitted these statistics the State Commission of Horticulture wishes to acknowledge its indebtedness. We hope that those who have kept similar records will send them to us for publication in future issues.

COST OF DEVELOPING A FIVE ACRE ORCHARD OF PEACHES AND PLUMS, LAND CONSISTING LARGELY OF HARDPAN CLAY SOIL, ORANGEVALE, CAL.

(Orchard of Mr. E. Hoffner.)

This land has been idle for several years, and when planted was practically virgin soil. Planting was started the latter part of March of this year. In giving the cost of planting and cultivating this land, personal labor has been charged at same rates paid to hired labor. Land that does not require blasting can be planted cheaper than this. This land is not piped or irrigated. The additional cost for piping and irrigating would be approximately $100 for the first year, after that $25 a year for water and distributing it.

Cost of land at $125 per acre		$625 00
Cost of planting land—		
Plowing 5 acres	$11 00	
Cultivating 6 times	12 50	
Blasting 200 holes	20 00	
		43 50
Cost of planting trees—		
Cost of peach trees (324 trees)	$32 40	
Cost of Climax plums (112 trees)	11 00	
Cost of Santa Rosa plums (112 trees)	11 00	
Hauling trees	2 50	
Planting trees	100 55	
Pruning back to 2 feet	2 00	
		159 43
Total cost, including cost of land		$827 93
Estimated cost for piping and irrigating first year		100 00
Total, with irrigation facilities		$927 93

COST OF DEVELOPING A TEN ACRE PRUNE ORCHARD IN BUTTE COUNTY.

Cost of land		$2,250 00

1914.

Plowing	$28 50	
Trees (805 at 13 cents)	104 65	
Planting	59 71	
Cultivating (4 times during season)	39 30	
1,000 tree protectors	8 25	
Pumpkin seed	75	
Cultivating and planting pumpkin seed	12 90	
Sulphur (140 pounds)	4 25	
Sulphuring (2 times during season)	2 00	
Digging Johnson grass (4 different times)	11 00	
Hoeing trees and sulphuring	4 00	
Hoeing trees and spading Johnson grass	4 00	
Taxes	15 00	
Pruning	5 00	
		299 31
		$2,549 31
Receipts from pumpkins, which were planted between the trees		45 00
Total		$2,504 31

1915.

Trees to reset	$22 25	
Resetting trees	13 30	
Burning brush	2 00	
Plowing	33 00	
Hoeing trees (2 times)	10 00	
Cultivating (6 times during season)	47 00	
Whitewashing trees	8 64	
Sulphuring and digging Johnson grass	7 00	
Gopher traps	2 40	
Trapping gophers through summer	7 00	
Picking caterpillars from trees	2 75	
Taxes (first installment)	10 98	
		166 32

1916.

Pruning	$7 50	
Burning brush	3 00	
Trees to reset	3 00	
Resetting trees	4 00	
Plowing	31 50	
Hoeing (2 times during season)	11 00	
Cultivating (8 times over during season)	32 00	
Cutting Johnson grass and thistles on county road	1 00	
Whitewashing trees	10 00	
Taxes (second installment)	8 37	
		111 37
Total		$2,781 20
Cost of land		2,250 00
Total, less cost of land at end of third year		$532 00

COST OF DEVELOPING A TWENTY ACRE ORCHARD OF PEARS AND APPLES, ON GOOD FOOTHILL SOIL IN BUTTE COUNTY.

(Orchard of Mr. E. Meriam, Paradise.)

The land when purchased was rough land. Nearly the entire work was done by hired men and teams, day work, often not immediately superintended. The wages were usually $2 for nine hours labor, and $4 for man and team. Not much personal time was given to the work, so no account was kept of it. However, it would be fair to add 10 per cent to the cost for personal labor. (If any one should use these figures as a basis for his own operation, if he intends to do his own work, he should deduct 10 per cent because an owner usually works more intelligently and harder than an employee.)

The land was covered as follows: Ten acres in native forest of fairly heavy growth oak, pine and manzanita, and ten acres in stumps and logs with a second growth manzanita, which required mattocks to remove. The removal of rocks was not an important item of expense, possibly $50. In the spring of 1913, as many men were employed as possible to clean the land quickly, and especially to cut the marketable wood, with the expectation that the wood would pay in large part for the clearing. This worked out very satisfactorily.

By June, 1914, the rough land was sufficiently cleared to permit plowing half of it and the setting of 1,000 trees. The next year, in January, 1915, the remainder of the 20 acres was planted. There are now on the place 850 pear trees, 850 apples and 100 border trees of cherry and walnut. These trees are vigorous and of good size for their age. The items of expense which remain until trees come into bearing consist of cultivation and plowing. For this $200 a year will undoubtedly be sufficient. The actual expenditures to date (March, 1913—August, 1916), are as follows:

Cost of land at $50 per acre		$1,000 00
Blasting powder	$49 90	
Tools for clearing	9 60	
Wood cutting and clearing	717 30	
Wood hauling to market	371 90	
Incidentals in clearing	2 60	
		1,151 30
		$2,151 30
Planting the orchard:		
Rabbitproof fence and construction	$121 15	
Orchard tools	15 20	
Cost of trees (best of their kind)	218 35	
Tree planting (entire process)	261 45	
		616 15
Care of orchard:		
Plowing and cultivating	$211 50	
Lime for whitewash, etc.	3 00	
Pruning (largely done by self)	5 75	
		220 25
Total cost including land		$3,987 70
Received for wood		906 10
Net expense, exclusive of personal service		$3,081 60

COST OF DEVELOPING A SIXTY-FOUR ACRE OLIVE AND ORANGE ORCHARD NEAR RIO LINDA, CALIFORNIA.

(In charge of Mr. John Hoefling.)

The land which is set out to trees is composed of seven blocks, ranging in size from eight to ten acres, with a total of sixty-four acres. The seven individuals who own these small tracts, for the sake of economy, placed Mr. John Hoefling, one of the owners, in charge of the whole proposition, and agreed to have the work done in common and to have one irrigating plant centrally located. The water is delivered to each block by underground pipe lines. Expenses are defrayed by each paying a pro rata on all permanent improvements and on all work done on the place.

The cost of this proposition for the first three years is as follows:

Cost of land at $225 per acre		$14,400 00
Labor (total of all farms)	$3,139 00	
Trees (direct from nursery)	1,425 50	
Irrigating plant complete	1,496 50	
Blasting material	412 00	
Distillate and oil	86 00	
Total operating cost		6,559 00
Total cost of 64 acres including land		$20,959 00

This is an average, at the end of three years, of $327.50 per acre.

The trees consist chiefly of olives and oranges. Their total number is 4,233, or approximately 66 trees per acre. They were planted as follows:

Spring of 1914	728
Spring of 1915	2,420
Spring of 1916	1,085

The material for the irrigating plant consists of engine, pump, tank, lumber, cement and approximately 2,000 feet of iron pipe. Labor includes all work in building pumping plant, leveling, blasting, planting, irrigation and cultivation.

CROP REPORT AND STATISTICS.

MONTHLY CROP REPORT.

(October 1, 1916.)

BY GEO. P. WELDON.

Compiled from the reports of the County Horticultural Commissioners.

County	Grapefruit	Lemons	Olives	Oranges
Alameda	#	#	#	#
Butte	#	#	40	100
Colusa	#	#	#	#
Contra Costa	#	#	#	#
El Dorado	#	#	#	#
Fresno	#	100	100	90
Glenn	#	#	#	#
Humboldt	#	#	#	#
Imperial	#	#	#	#
Kern	#	#	100	100
Kings	#	#	#	#
Lake	#	#	#	#
Los Angeles	100	90	80	90
Madera	#	#	100	#
Mendocino	#	#	#	#
Merced	#	#	90	#
Modoc	#	#	#	#
Monterey	#	#	#	#
Napa	#	#	#	#
Nevada	#	#	#	#
Orange	100	100	75	100
Placer	#	#	70	#
Riverside	100	90	60	80
Sacramento	100	100	80	95
San Benito	#	#	#	#
San Bernardino	80	90	75	95
San Diego	100	75	100	100
San Joaquin	#	#	75	#
Santa Barbara	#	85	100	#
Santa Clara	#	#	#	#
Santa Cruz	#	#	#	#
Shasta	#	#	10	#
Siskiyou	#	#	#	#
Solano	#	#	#	#
Sutter	#	#	#	#
Sonoma	#	#	75	#
Stanislaus	#	#	90	90
Tehama	#	#	60	#
Tulare	95	95	90	90
Ventura	#	100	—	100
Yolo	#	#	60	#
Yuba	#	#	60	#

Figures in table indicate condition of crop in per cent, on the basis of 100 normal.
Crop not grown commercially.
—Horticultural Commissioner has insufficient information for report.

STATISTICS.

Estimated per cent of the total crop of the principal California fruits grown in each of the main producing counties during a season of normal production. Compiled from the reports of the county horticultural commissioners.

County	Almonds (per cent)	Apples (per cent)	Apricots (per cent)	Cherries (per cent)	Figs (per cent)	Lemons (per cent)	Olives (per cent)	Oranges (per cent)	Peaches (per cent)	Pears (per cent)	Plums (per cent)	Prunes (per cent)	Walnuts (per cent)
Alameda	*		14	9						2	*	*	
Butte	12	*		*	3	*	14	*	3	2	*	2	
Colusa	4		*						*	*		*	
Contra Costa	11	*	*	*					*	6	*	*	
El Dorado		*		*					*	3	*		
Fresno			5		53	*	3	*	29			*	
Glenn	*		*								*		
Humboldt		2											
Imperial			*		*								
Inyo		*							*				
Kern		*	*					*	*	*	*	*	
Kings			5						6			*	
Lake	*	*	*						*	8		*	
Los Angeles	2	2	4		*	31	14	26	4	*	3	*	30
Madera	*	*	*		3		2		*			*	
Mendocino		*								*		*	
Merced	*		*		9		*		3				
Modoc													
Monterey	*	12	2	*						*			
Napa	*	*	*	*	*		*		*	4	*	4	
Nevada		3	*	*					*	*	*		
Orange			4			7		10					38
Placer	*	*		3	*		*		6	7	39		
Riverside	3	*	7	*		16	11	14	*	*		*	
Sacramento	6		*	5			5	*	*	18	8	*	
San Benito	*		6	*					*	*	*	3	
San Bernardino		4	4	*		13	7	31	5				2
San Diego	*	*	*			10	5	*	*				
San Joaquin	12		3	25	*		4		8	4	*	*	
San Luis Obispo	*	*	*										
Santa Barbara		*	*	2		*	2						10
Santa Clara	*	*	21	26	*				5	9	18	55	
Santa Cruz		51	3	2					*			*	
Shasta	*	*					*		*	*		*	
Siskiyou		*											
Solano	6		3	10					3	6	16	4	
Sonoma	*	16	*	9	*		5		*	6	*	12	
Stanislaus	6		*	*	5			*	3	*			
Sutter	9				8		*		2	*	*	*	
Tehama	*	*	*		*		11	*	*	2	*	*	
Tulare	*		*		6	5	6	13	9		2	4	
Ventura			6			15		2					20
Yolo	11		5		5		3		2	9	4	2	
Yuba	*				2		3	*	*	*	*		

*Less than 2 per cent of state's normal crop grown in county.

THE MONTHLY BULLETIN

CALIFORNIA STATE COMMISSION OF HORTICULTURE.

DEVOTED TO HORTICULTURE IN ITS BROADEST SENSE, WITH SPECIAL REFERENCE TO PLANT DISEASES, INSECT PESTS, AND THEIR CONTROL.

Sent free to all citizens of the State of California. Offered in exchange for bulletins of the Federal Government and experiment stations, entomological and mycological journals, agricultural and horticultural papers, botanical and other publications of a similar nature.

Entered as second class matter December 29, 1911, at the post office at Sacramento, California, under the act of June 6, 1900.

New Citrus Quarantine.—Quarantine Order No. 28, which became effective on September 21st, gives the California citrus growers the best possible protection against the dread canker disease which at present occurs in Louisiana, Mississippi, Alabama, Florida, Texas and Georgia. An absolute quarantine against the importation of all citrus fruits and citrus trees, including buds and scions, from any state or territory of the Union is now maintained under this order. While these provisions may seem somewhat drastic to those who are not in close touch with the situation, they could not be made any less drastic and give to our greatest fruit industry the protection which it should have. Before the passage of the order, Florida was the only state which could not send either citrus trees or citrus fruits into California. Now not only Florida and other states where citrus canker is known to exist, but all other states and territories of the Union, must not ship into this state. It was considered necessary to include all states and territories, not because citrus trees or fruits are grown in them, but because of the possibility of fruit being shipped from one state to another and then reshipped to California. Now that every avenue is closed California citrus growers should feel reasonably safe as far as citrus canker is concerned, and it is hoped that this action will result in absolute protection.—G. P. W.

QUARANTINE ORDER NO. 28.

September 21, 1916.

Canker of Citrus Fruits and Citrus Trees

The fact has been determined by the State Commissioner of Horticulture that a contagious disease, injurious to citrus fruits and citrus trees, known as Citrus Canker (*Pseudomonas citri*), new to and not heretofore prevalent or distributed in the state of California, exists in several states of the United States, and that the nature of this disease

is so virulent as to cause the United States Department of Agriculture to issue a quarantine against the introduction of citrus nursery stock of every variety from all foreign countries.

Now, Therefore, it is declared necessary, in order to prevent the introduction of Citrus Canker into the state of California, that a horticultural quarantine be and the same is hereby established at the boundaries of the state of California, in accordance with the provisions of section 2319*b* of the Political Code of the state of California, against all citrus fruits and citrus trees of every variety, including buds and scions, imported or brought from any state or territory of the United States; and no such citrus fruits or citrus trees shall be permitted to pass over the said quarantine lines so hereby established and proclaimed.

Hereafter, and Until Further Notice, all citrus fruits and citrus trees, including buds and scions, from the aforementioned states and territories are denied admittance into the state of California; and upon the arrival of any such fruits or trees as quarantined against in this order, the same shall be immediately sent out of the state, or destroyed, at the option and expense of the owner, consignee or agent. All deputies of the State Commissioner of Horticulture, and State Quarantine Guardians are hereby empowered to carry out the provisions of this order.

The foregoing regulations do not apply to the experiments of the United States Department of Agriculture in the state of California.

GEO. P. WELDON,
Acting State Commissioner of Horticulture.

Approved:
HIRAM W. JOHNSON,
Governor of the State of California.

Standing Committee on the Revision of Horticultural Laws.—In appointing the standing committee which is to be entrusted with the exceedingly important task of revising our horticultural statutes, the temporary committee delegated with this power, has tried to give fair representation to the growers and shippers of both citrus and deciduous fruits. In addition, the State Association of County Horticultural Commissioners, the State Commission Market, the State Viticultural Commission and the State Agricultural Society, are each represented. The personnel of the committee is such that there will necessarily be a wide variance of opinion regarding many matters which are brought before it for discussion. There could be no better place than in a meeting composed of representative men from the different interests, to exchange ideas and if possible finally agree on a program which can be supported by all. If there are interests not represented which should be, it is only because the appointing committee has overlooked these interests. Certainly it is their intention to slight no one, and all appointments have been made with the greatest of care and in a spirit of fairness toward all.

Already individual members of this committee are known to be working hard in order that their ideas on certain phases of legislation may assume definite form for presentation and discussion at the meetings.

Following is a complete list of the members of the standing committee:

W. W. Hinsey, Fairoaks Fruit Company, California Olive Association; J. J. Brennan, California Fruit Exchange; E. W. Lewis, W. O. Davies, Florin, California; J. W. Jeffrey, State Viticultural Commission; A. W. Tate, Watsonville Apple Distributers, Corralitos Fruit Association; A. L. Wisker, Colfax Fruit Association of Placer and Nevada Counties; C. F. Collins, State Association of Horticultural Commissioners; A. J. Sturtevant, California Peach Association; Frederick Maskew, State Horticultural Quarantine Service; O. E. Bremner, State Association of Horticultural Commissioners; S. A. Lines, Earl Fruit Company; Geo. P. Weldon, E. J. Wickson, Geo. H. Hecke, temporary committee; F. B. McKevitt, California Fruit Distributors; C. C. Teague, California Fruit Growers Exchange; Geo. C. Roeding, State Agricultural Society; Harry Chase, Riverside, California; C. C. Chapman, Fullerton, California; James Mills, Willows, California; Col. Harris Weinstock, director, State Commission Market; Chas. W. Paine, secretary, State Agricultural Society; E. N. Richmond, San Jose, California; E. A. Gammon, Hood, California; John E. Gardiner, Watsonville, California; W. A. Yerxa, Princetown, California; Carlyle Thorpe, manager, California Walnut Growers' Exchange; Geo. W. Pierce, Davis, California; W. D. Russell, Davis, California; James Madison, California Associated Raisin Company; Hon. B. B. Meek, Oroville, California; D. D. Sharp, County Horticultural Commissioner, Riverside, California; Roy K. Bishop, County Horticultural Commissioner, Santa Ana, California; William Wood, County Horticultural Commissioner, Los Angeles, California; L. M. Speighl, Washington and Davis streets, San Francisco, represents San Francisco commission men; J. Nagle, California Fruit Exchange; C. E. Virden, California Fruit Distributors; G. H. Powell, California Fruit Growers Exchange; E. H. White, 392 Washington st., San Francisco; H. E. Butler, Penryn, California; John E. Boal, National City, California.—G. P. W.

The Citrophilus or Upland Mealy Bug.—The citrophilus or so-called "Upland"* mealy bug, *Pseudococcus citrophilus* Clausen, is unusually abundant in the San Francisco Bay region, attacking a large number of plants. In greenhouses it is apparently as severe as the citrus mealy bug, *P. citri* (Risso).

At the Mission San Jose this insect has become very abundant in the small citrus orchards of that section. In all from ten to fifteen acres are infested and the infestation is as severe as any infestation of the citrus species the writer has ever seen. The fruit, leaves, limbs and trunks of oranges and lemons alike are festooned with the egg masses and colonies of insects.

This is an important observation, for one of the questions which arose at the Ontario Convention was whether or not this insect would be as serious as the citrus species. At that time no one knew the real status of the particular mealy bug in question, and I am inclined to feel that we are still very much in the dark as to its origin and identity, but since the convention a great deal has been learned about its distribution and food plants and the observations of the writer thoroughly convince him that so far as seriousness is concerned it ranks with the regular species, especially if the infestation at the above mentioned place is to be taken as typical.

Dr. A. G. Smith has also reported a number of cases of infestation at Pasadena, indicating, with the other known records, that this insect is quite generally spread throughout the state.

*References to this species as the Ontario mealy bug are misleading, as it does not occur at that place. The name arose from the convention held there to discuss this and other mealy bugs.

All the information at hand, then, would indicate that this species is as severe as the citrus mealy bug and should be handled, from a legislative standpoint, and treated in much the same way, when established in a district.—E. O. ESSIG, Department of Entomology, University of California.

The Agricultural Value of Impermeable Seeds.—The Journal of Agricultural Research, issued August 14, 1916, contains an article by George T. Harrington on "The Agricultural Value of Impermeable Seeds." There is so much of interest in this article to the farmer that the writer is giving a short summary of it here, largely in the words of the text, with a few notes and conclusions, in the hope that it will be of assistance to the farmers of this state:

"By 'impermeable seeds' is meant those seeds all parts of whose seed coats are impermeable to water at temperatures favorable for germination.

"It is impossible to distinguish between impermeable and permeable seeds except by testing their ability to absorb water at a temperature favorable for germination.

"The production of impermeable seeds is particularly characteristic of the Leguminosæ, but it occurs also in many other plant families.

"Impermeable seeds frequently retain their vitality for many years, sometimes for as many as eighty years.

"Fresh impermeable seeds germinate promptly when the seed coat is broken or becomes permeable.[1]

"The viability[2] of fresh impermeable seeds is frequently greater than the viability of fresh seeds of the same species which are permeable.

"Seeds of the common clovers, alfalfa and hairy vetch, which are impermeable at the end of three or five years under laboratory conditions of storage, retain their vitality apparently unimpaired up to that time. The viability of the permeable seeds in the same lots decreases slightly in the second and third year and more in subsequent years.

"In dry storage nearly all impermeable alsike clover, white clover and sweet clover seeds remain impermeable until at least two or three years old. Impermeable red-clover seeds become permeable gradually in dry storage, but from one-third to two-thirds of them may still be impermeable after four years. The majority of impermeable alfalfa and hairy vetch seeds become permeable before they are two years old. Okra seeds become less permeable as their age increases.

"Impermeable clover seeds which were thoroughly matured before harvesting soften and germinate more slowly under conditions favorable for germination than do impermeable seeds of the same species which were less well matured; they also become permeable more slowly in dry storage.

"It is impossible to estimate even approximately in advance the proportion of the impermeable seeds in any given lot which will germinate in any given length of time under ordinary germination conditions.

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[1]This end is sometimes accomplished by scratching the seeds in a machine before planting.

[2]Viability means germinating properties.

RESULTS FROM SOWING HARD SEEDS.

"Within ordinary limits neither the depth of planting nor the firmness of the soil affects the germination of impermeable clover and alfalfa seeds under greenhouse conditions. These factors may affect the stand secured by preventing some of the seedlings from reaching the surface, and even under the most favorable conditions only a small proportion of impermeable red clover, alsike clover, white clover and white sweet clover seeds produce seedlings promptly in the soil when sowed in warm weather.

"Impermeable seeds of red clover, alsike clover, white clover and white sweet clover will pass the winter in the soil in a freezing climate without injury. At least 50 to 60 per cent of them may be expected to germinate in the soil the following spring unless a part of them germinate during the warm weather in the winter. If this occurs, the seedlings produced in the winter are liable to be killed by subsequent freezing. Frequently a large proportion of impermeable alfalfa, crimson clover, okra and hairy vetch seeds will germinate in the soil during the first few months after planting, some of them early enough to be of importance to the crop. Nearly all alfalfa and okra seeds, even if they are impermeable in the fall, are killed when they pass the winter in the soil or on the plants out of doors in a freezing climate. A small proportion of the impermeable alfalfa seeds survive with their vitality unimpaired. Some of the okra seeds remain impermeable during the winter, but the majority even of those which remain impermeable are killed by the winter's exposure."[3]

VALUE OF HARD SEEDS.

The value to the farmer of impermeable seeds occurring in any lot of seed will vary according to the kind of seed, the germinating capacity, the percentage of impermeable seeds in the lot of seed under consideration, the age of the seed, and the time of sowing the seed. Impermeable alfalfa seed sowed late in the spring is of more value to the crop than impermeable sweet clover seed sowed at the same time.

If the percentage of impermeable seed in a given lot is small (10 per cent or less), and the rest of the lot consists of strong, germinable seeds, the impermeable seeds are of little importance both because of their fewness in comparison with the seeds which germinate readily, and because of the varying quantities of seed which are sowed according to common practice. It is when the impermeable seeds constitute a large percentage of the seed in a given lot that their real value becomes a question of agricultural importance.

In seed that is several years old the viability of the permeable seeds may have become so low that the impermeable seeds, which lose their vitality more slowly, are relatively much more important than in lots of fresh, new seeds.

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[3]The winter temperatures referred to in this article are those of the Eastern States. Our California winters are rarely cold enough to kill seeds planted in the fall.

Impermeable clover seed sowed early in the spring is of more value than the same seed sowed later, when the weather has become settled and warm, because many of the permeable seeds may possibly be killed by the early spring weather.

Assuming that all seeds have been tested for germinating capacity and percentage of impermeable (hard) seeds, calculate the amount of seed to sow as follows:

Red clover, alsike clover, white clover and white sweet clover. When seed is to be sowed in late spring or summer, calculate one-tenth of the impermeable seed as good. Add one-tenth of the percentage of impermeable seed to the percentage of germination. Calculate from this sum the quantity of seed of the given lot necessary to give the desired quantity of good germinable seed. For example:

Required: 15 pounds of viable seed to acre, none of which is hard seed.

Test of seed bought 50 per cent germination, 40 per cent hard seed; $50+{}^{40}/_{10}$ equals 54, the total per cent of seed which will germinate from each pound of tested seed. To get the number of pounds of such seed necessary to sow per acre to equal 15 pounds viable seed, divide 15 by 54 per cent, which equals 27.8, the number of pounds of seed required per acre.

For alfalfa and crimson clover consider two-thirds of the percentage of "hard seeds" as good, and proceed as above.

For hairy vetch consider one-half the impermeable seed as good and proceed as under red clover.

As a general rule it can be said that hard seeds are of doubtful value. In California the winters are so mild that seed sown in the fall readily germinates with the first rains. Under such conditions the permeable or soft seeds start first—the seedlings quickly shade the ground and the hard seeds never develop. It is probable that the many poor stands of alfalfa and clover in California are due to the low germinating quality of the seed. We take this opportunity to suggest again that samples of all agricultural seed should be sent to the university for testing before making any purchase. We know that better crops will more than pay for the trouble.—O. W. Newman.

Program Forty-ninth State Fruit Growers' Convention.—The following is the completed program of the Forty-ninth State Fruit Growers' Convention which is to be held at Napa, November 15th, 16th and 17th. Just a glance at the program will convince the fruit grower that this convention will be one of the best ever held in the state and that he can not afford to miss it. The program of the convention of the State Association of the County Horticultural Commissioners is also included in this issue, and to our mind is a remarkably good one.

PROGRAM.

FORTY-NINTH STATE FRUIT GROWERS' CONVENTION.

Wednesday, November 15, 10 a.m.

Address of Welcome. E. J. DRUSSEL, Mayor of Napa.

Response. G. H. HECKE, State Commissioner of Horticulture, Sacramento.

Report of Committee on Legislation.

The Dried Pear Industry.
FRED. G. STOKES, Horticultural Commissioner, Lake County.

Discussion. F. T. SWEET, Horticultural Commissioner, Contra Costa County.

Wednesday, November 15, 2 p.m.

Weaknesses in Our Fresh Fruit Standardization Law.
F. B. MCKEVITT, President California Fruit Distributors, Sacramento.

Discussion.

Practical Application of the Law with Grapes.
FRED P. ROULLARD, Horticultural Commissioner, Fresno County.

Practical Application of the Law with Deciduous Fruits.
H. E. BUTLER, Manager, Penryn Fruit Company, Penryn.

The Future of the Wine Grape Industry in California.
E. M. SHEEHAN, Secretary, State Viticultural Commission.

The Future of the Raisin Industry.
JAMES MADISON, Manager, The California Associated Raisin Company, Fresno.

Thursday, November 16, 10 a.m.

The Prune and Apricot Growers' Information Bureau.
G. H. BONE, President of the Prune and Apricot Growers' Information Bureau, San Jose.

Discussion. HARRY DUNLAP, Napa; J. C. SHINN, Niles.

Standardization of the Apple Under the Act of 1915.
F. S. JEROME, President Watsonville Apple Distributors, Watsonville.

Thursday, November 16, 2 p.m.

Scientific Distribution of Fruit.
COLONEL HARRIS WEINSTOCK, Director State Commission Market.

General Discussion.

The New Peach Growers' Organization and What it Means to the Peach Grower.
J. C. RORDEN, Director, California Peach Growers' Association, Fresno.

Thursday, November 16, 7:30 p.m.

The California Farmer and the College of Agriculture.
DR. T. F. HUNT, Dean, College of Agriculture, University of California, Berkeley.

Friday, November 17, 10 a.m.

Disposition of Fruit Below the Established Standard.
H. C. ROWLEY, Publisher California Fruit News, San Francisco.

Improvement of Nursery Stock.
A. L. WISKER, Loma Rica Nurseries, Grass Valley.

Discussion. { GEORGE C. ROEDING, Fancher Creek Nurseries, Fresno.
LEONARD COATES, Leonard Coates Nurseries, Morganhill.

Friday, November 17, 2 p.m.

Marketing Through the Medium of the Parcel Post.
S. GLENN ANDRUS, Secretary of the Sacramento Chamber of Commerce.

Rural Credits.
DR. ELWOOD MEAD, Professor of Rural Institutions, University of California, Berkeley.

TENTATIVE PROGRAM.

CONVENTION STATE ASSOCIATION OF COUNTY HORTICULTURAL COMMISSIONERS. NAPA, CALIFORNIA.

CHAS. F. COLLINS, President. HOWARD G. KERCHEVAL, Secretary.

Monday, November 13, 10:30 a.m.

Beneficial Insects of Most Economic Value.	HARRY S. SMITH.
Injurious Insects and Their Control.	E. O. ESSIG.
The Mealy Bug in Vineyard and Orchard.	R. L. NOUGARET. WILLIAM WOOD.

Monday, November 13, 1:30 p.m.

Pear Thrips.	J. W. MILLS.
Some Aspects of Citrus Pest Control.	H. J. QUAYLE.
Cover Crops in Deciduous Orchards.	W. M. MERTZ.

Monday, November 13, 7:30 p.m.

Fungous Diseases of Deciduous Fruits.	RALPH E. SMITH.
The Little Leaf Disease of the Vine.	FREDERIC T. BIOLETTI.

Tuesday, November 14, 9 a.m.

A State-wide Campaign Against Weeds.	J. B. HICKMAN.
Report of the Legislative Committee on Proposed Amendments to the Horticultural Laws.	O E BREMNER.

Tuesday, November 14, 1:30 p.m.

How Our Horticultural Laws Affect Fruit and Produce Merchants.	DUDLEY MOULTON.
Application of the Standardization Law and Suggestions for its Improvement.	HON. GEO. W. ASHLEY. C. K. TURNER.

Tuesday, November 14, 7:30 p.m.

Discussion of Any Subjects of Interest.
In Charge of Vice President, D. D. SHARP.

OFFICERS OF THE CONVENTION.

G. H. HECKE, State Commissioner of Horticulture ------------------President.
E. J. VOSLER, Secretary, State Commission of Horticulture----------Secretary.

Information Bureau.

The Napa Chamber of Commerce will conduct an Information Bureau for the benefit of those attending the convention.

Railroad Rates.

The usual one and one-third rate on the receipt certificate plan has been secured for the convention providing fifty people take advantage of this rate. Secure a one-way ticket from your local ticket agent and ask for a receipt certificate. This when properly endorsed by the secretary of the convention and presented to the ticket agent at Napa will insure a one-third rate home.

Tractor Demonstrations.

Twenty-five acres have been secured for the tractor demonstrations. All of the best known makes of tractors will participate.

Industrial Exhibit.

An extensive industrial exhibit has been arranged for. This will be held in the Exhibition Hall at Napa.

The Convention will be held in the Opera House of Napa.

All Avocado Growers Are Urged to Be Present

THE FOURTH SEMIANNUAL MEETING AND EXHIBIT

of the

CALIFORNIA AVOCADO ASSOCIATION

Is to be held in the Maryland Hotel, San Diego, California, October 30 and 31, 1916.

Exhibit of Fruits, Nursery Stock, Etc.

Special emphasis is to be placed on the exhibit of fruits. In previous meetings the exhibits of fruit have attracted great interest, and is one of the most valuable features of the Association meetings. It is expected that the exhibit at this meeting, which is to be placed in a special exhibit room, will be the largest and best ever held. The Directors have decided that the exhibit shall be educational only and non-competitive. All growers of avocados are urged to make a special effort to install good exhibits of their fruits, as it is highly important in this early stage of the industry to extend the knowledge of varieties and of the possibilities of the industry.

Exhibits of nursery stock, diseases, etc., will also be welcome additions. Exhibits of nursery stock are limited to 6 trees from a single individual or company.

All exhibits are expected to be in place by 6 p.m., October 30th, before the evening reception. All correspondence and questions with reference to exhibits should be addressed to Mr. T. U. Barber, 518 Van Nuys Building, Los Angeles, California.

Material forwarded for exhibition should be addressed to California Avocado Association, Maryland Hotel, San Diego, California.

Evening Reception.

An evening reception open to all members of the Association and to invited guests is to be held at the Maryland Hotel, October 30th, at 8 p.m.

Regular Meeting.

To convene at 9 a.m., October 31st, at the Maryland Hotel, San Diego, California.

The program at this session will include papers from well known men in California and from various parts of the world where avocados are grown.

The following are some of the papers that will be presented:

The Avocado Industry and the Avocado Association. Presidential Address—Dr. H. J. Webber, Citrus Experiment Station, Riverside, California.

The Growing of Avocados in Hawaii—Prof. J. H. Higgins, Horticulturist Government Experiment Station, Honolulu, Hawaii.

Avocado Growing in Porto Rico—Tracy Bartholomew, Garrochales, Porto Rico.

The Production and Consumption of Avocados—Thomas H. Shedden, Monrovia, California.

The Avocado in Mexico—R. V. Price, Upland, California.

Fruiting Habits of Budded Trees of the Different Avocado Varieties—T. U. Barber, Los Angeles, California.

Methods of Propagating the Avocado—F. O. Popenoe, Altadena, California.

Has the Mexican Type of Avocado a Permanent Place in the Industry?—E. S. Thacher, Nordhoff, California.

Methods of Avocado Growing in the Tropics Applicable to California—E. E. Knight, Yorba Linda, California.

Marketing From the Florida Viewpoint—Lloyd S. Tenny, Miami, Florida.

A Bark Disease of Avocado Trees—PROF. H. S. FAWCETT, Citrus Experiment Station, Riverside, California.

Our Experience in Growing the Avocado—W. G. FRASER, Manager Riverside Orange Company, Riverside, California.

Experiences with Avocado Varieties and Necessity of Co-operation—CHAS. D. ADAMS, Upland, California.

What About the Avocado?—C. E. UTT, Tustin, California.

The History and Performance of Avocado Varieties in California—PROF. I. J. CONDIT, College of Agriculture, Berkeley, California.

It is expected that demonstrations will be given during the meeting of methods of preparing and serving the avocado. All will be given an opportunity to test the various preparations.

Inquiries regarding rooms and general arrangements for the meeting should be addressed to the Chairman of the Local Entertainment Committee, Mr. W. H. Sallmon, 401 Southern Title Building, San Diego, California.

All avocado growers, whether members or not, are urged to attend.

CALIFORNIA AVOCADO ASSOCIATION.
General Office at Citrus Experiment Station, Riverside, Cal.

OBSERVATIONS ON THE LESTOPHONUS, A DIPTEROUS PARASITE OF THE COTTONY CUSHION SCALE.[1]

By Harry S. Smith and Harold Compere.

The function of the state insectary, as is generally well known throughout California, is the importation and colonization of parasites and predaceous insects which appear to be of value in controlling the injurious forms in foreign countries and which give promise of effective work here. In order to conduct such work intelligently and to carry it on without danger to agricultural interests, a considerable amount of research work in life histories and habits of parasitic and predaceous insects is required. Further than that, a broad knowledge of the habits of such insects in general is a necessity in problems of this kind. It

Fig. 128.—Drawing of the adult Lestophonus, greatly enlarged. (Original.)

was mainly the idea of thus broadening our knowledge of insect parasitism in general that led us to make the observations on the Lestophonus[2] recorded on the following pages, and the hope of helping others who are carrying on similar lines of work leads us to publish them.

The discovery, importation and successful establishment of the Lestophonus in California as an adjunct in the control of the Cottony Cushion scale forms a chapter in economic entomology hardly less fascinating than that of the famed Vedalia, and if the facts were known we would probably find that to this parasite is due at least a portion of the good work for which Vedalia receives credit.

[1]Occasional contributions from the California State Insectary No. 3.

[2]As explained later on in the article, the technical name of this parasite is *Cryptochætum monophlebi* (Skuse), but since the insect is popularly known as the *Lestophonus* in California we prefer to use this name in the title.

IDENTITY OF THE SPECIES.

An insect which was originally supposed to be the same as the one under discussion was described by Doctor S. W. Williston from material collected in Australia by Mr. Fraser S. Crawford in 1888 and sent to the United States Department of Agriculture. Dr. Williston was unable to place the insect in any known genus, this necessitating the erection of a new genus which he called Lestophonus, naming the species *iceryæ* after its host. Practically all the notes published on this parasite appear in the literature under the name of *Lestophonus iceryæ* Williston. Soon thereafter Skuse described a second species of Lestophonus from Australia which he called *monophlebi.* It has recently been determined by Mr. Frederick Knab of the United States National Museum that the species we have in California, or at least the material which he studied from California, is the *monophlebi* of Skuse and not the *iceryæ* as described by Dr. Williston. While it is possible that both species were successfully introduced into California it is hardly likely,

FIG. 129.—Lestophous ovipositing in an immature cottony cushion scale. Enlarged. (Original.)

and at any rate the species studied at the insectary is according to Mr. Knab's table for determination of the species *monophlebi* Skuse. Dr. Williston wrote later that in his search for a genus for this parasite he had overlooked the genus Cryptochætum erected by Rondani for the European species *grandicorne* in 1875, and which is congeneric with the species under discussion. The name of this parasite then, according to the best information available, should be *Cryptochætum monophlebi* (Skuse).

DISCOVERY AND INTRODUCTION INTO CALIFORNIA.

So far as we are able to learn from the literature the first mention of this parasite was the original description by Dr. Williston in July, 1888. At that time the Cottony Cushion scale had reached the climax in its abundance and the citrus growers were appealing to Washington for relief. Dr. L. O. Howard, then first assistant in the Division of Entomology under Dr. C. V. Riley, had been making some investigations through correspondence into the Australian enemies of Icerya with the object in view of attempting the introduction into California of any promising forms discovered. As a result of his correspondence Mr. Frazer S. Crawford of Adelaide, Australia, sent to the department specimens of the parasite. This discovery was the beginning of the

movement which finally resulted in sending Mr. Koebele to Australia under the joint auspices of the United States Department of Agriculture and the California State Board of Horticulture, and in the subsequent discovery and introduction of Vedalia, the success of which is known to all. It is interesting to note that it was this Dipterous parasite now known as *Cryptochætum monophlebi* and not the Vedalia that was the objective of Mr. Koebele's mission to Australia, and that the discovery of Vedalia was incidental to the search for and shipment of Cryptochætum. It is a pleasure to record here that Dr. Riley was correct in his statement made in 1889, that "the Lestophonus for the present has been overshadowed by the Vedalia, but its importance has not yet been appreciated."

On receipt of the specimens of Cryptochætum from Mr. Crawford, through Miss Ormerod, the English entomologist, the officials of the United States Division of Entomology immediately wrote to that gentleman, making the request that he send living material to the division agent in Los Angeles, Mr. D. W. Coquillet, in order to attempt the introduction of the species. Mr. Crawford generously had collected and sent to Mr. Coquillet a quantity of Icerya infested with the parasite. Material was also sent to Mr. Koebele at the same time. The scales were placed in cages enclosing infested orange trees and the parasites were seen to issue, but oviposition was not observed and it is not known whether the parasite was successfully established at this time.

It being evident to Dr. Riley that the chance for success would be much greater if larger colonies of the parasite could be had, the movement was then started which resulted in sending Mr. Koebele to Australia for the purpose of securing large quantities of the parasite material. In this he was very successful and 12,000 specimens were forwarded to Mr. Coquillet in Los Angeles, who succeeded in getting them established in the open.

Dr. Riley wrote in his report for 1888:

> "We fully expect to learn of the increase and rapid spread of this new introduction as well as some of the predaceous species which have been introduced, and to find that in a comparatively few years the orange groves of southern California will be kept measurably freed from the pernicious Fluted Scale without so great an effort on the part of the growers or so great expense in destroying it. That nature will, with the new conditions induced by these new importations, come to the relief of the fruit grower and that this interesting experiment will result in the ultimate saving of untold millions to the people of the Pacific coast is our sincere belief which we hope to live to see verified."

Koebele continued the shipment of parasites from time to time and large numbers were liberated in the orange groves from his sendings. From these original colonies the parasites spread to various sections of the state.

DISTRIBUTION AND ABUNDANCE IN CALIFORNIA.

While no extensive observations have been conducted on the distribution of this parasite, it is known to occur in most of the citrus sections inhabited by Icerya. It is common in Los Angeles, Orange, San

Diego, Santa Barbara and Sacramento counties and is said to be fairly common in Santa Clara. While the parasite is by nature perhaps more erratic than Vedalia, it at times becomes very abundant. We occasionally find 90 per cent or more of the scale infested. For some unknown reason it seems to be more abundant on acacias than on citrus trees, at least so far as our observations have gone. There is no doubt but that in some cases it has been a more important factor in the control of the Icerya than has Vedalia, although this would by no means be true taking the state as a whole.

DESCRIPTION OF THE ADULT FLY.

Small flies with a metallic dark blue luster; abdomen usually more shining and with a greenish tinge; antennæ blackish; legs black with lighter colored tarsi; wings broad hyaline; length averages 1.5 mm.

Head. Frons broad; center triangle shining; orbital triangles opaque and somewhat variable in size; front punctured with numerous short coarse hairs. Eyes large with miscroscopic black hairs. Antennæ with first and second joints small; third joint large and with an obtuse point, sometimes having a weak angulation almost imperceptible, usually with dense brown pubescence.

Thorax. Mesonotum close hairy, without bristle. Scutellum large, triangular, with a sharp edge and two apical bristles but slightly differentiated from the close-set hairs.

Legs. Legs black, the tarsi obscurely yellowish, and with a longitudinal series of short black hairs; no spurs or bristles.

Wings. Wings short: first vein distinctly angulate; auxiliary vein parallel with first vein; the costa twice broken; second and third veins divergent; second basal fused with the discal cell; anterior cross vein usually before end of first vein; posterior cross vein distinctly arcuate, the convexity toward the first posterior cell.

OVIPOSITION AND HABITS OF ADULT.

The adult flies are rather slow-moving and deliberate for Dipterons, although when confined in glass vials they become nervous and violent. They frequently kill themselves by dashing against the sides of the cage. The flies feed to some extent upon sweetened water and in this way we have succeeded in keeping them alive for a period of ten days, although as a rule they are not so long-lived in confinement. When ready to oviposit the female crawls slowly over the body of the scale insect, preferably about half grown, feeling the host more or less with its antennæ. The actual act of oviposition is accomplished very quickly, the fly simply lowering the tip of the abdomen, inserting the short ovipositor and placing the egg in the body cavity of the host scale. A single female sometimes deposits several eggs in the same host.

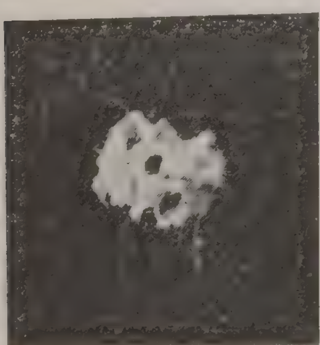


FIG. 130.—Cottony cushion scale showing the exit holes of Lestophonus. (Original.)

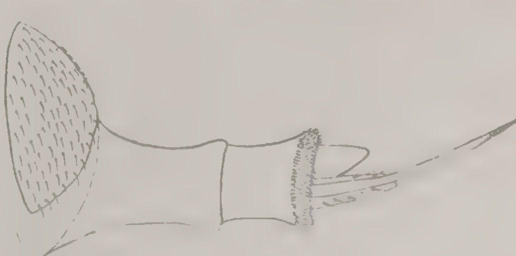


FIG. 131.—Lateral view of the last abdominal segment and extended ovipositor of Lestophonus. Greatly enlarged. (Original.)

THE EGG.

The egg of Cryptochætum is very minute, averaging about .3 mm. in length. It is oblong oval in shape, slightly wider at one end than at the other, pearly white in color and without visible sculpture. Owing to the difficulty of getting the flies to oviposit in confinement we have been unable to ascertain just how long the egg stage lasts, but indications are that it hatches in about four or five days. The eggs are quite numerous and it is probable that a single female deposits as high as 200 eggs. On the dissection of the adult insect we frequently find as high as 120 mature eggs in the ovarian tubes.

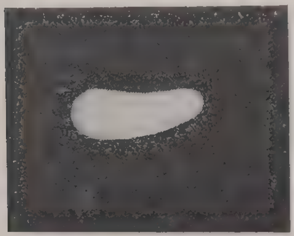


FIG. 132.—The egg. Greatly enlarged. (Original.)

THE YOUNG LARVA.

The young larva is a very curious creature, as will be seen by the accompanying illustration. It is found swimming about freely in the body cavity and at this stage apparently does not inconvenience its host in the least. The most conspicuous anatomical feature consists of the two long tails which are sometimes twice the length of the body. The larva is semitransparent with a conspicuous black mouth-hook. This mouth-hook consists of three pieces, as will be seen in the accompanying figure. The large posterior section, provided with two dorsal projections, is apparently useful in the main as a place for muscular attachment. The two "jaws" just anterior to this function in the taking in of food, and since in this stage no tissue of the host is destroyed, they probably serve to produce a current of the juices of the host toward the interior of the parasite. In living larvæ they are continually opening and closing like a pair of jaws. The anterior half of the larva is smooth, with sutures visible, however. The posterior half has a very curious integument, each segment being provided with a ring of cilia-like projections, broad at the base but terminating in a point and soft and flexible in structure. They are in length sometimes equal to the width of the larva, although usually hardly so long as that. The larva, as seen in the illustration, usually holds itself in the shape of a modified S. Usually there is but one larva to a scale, but at times as many as half a dozen are found.

FIG. 133.—The young larva. Greatly enlarged. (Original.)

FIG. 134.—Mouth-hook of the larva of Lestophonus. Greatly enlarged. (Original.)

THE MATURE LARVA.

The full-fed larva presents a quite different appearance from the young form. It is now no longer S-shaped, but is more properly described as pear-shaped. The two tails have become enormously lengthened, sometimes as much as three-fourths of an inch, and this is contained within a host which is frequently not more than 2 mm. in length. The mouth parts have undergone a considerable change, being relatively much shorter and stouter. The larva in this stage begins rapidly to destroy the tissues of the host, the latter now taking on a peculiar convex appearance which renders it easy to recognize the

FIG. 135.—The mature larva of Lestophonus. (Original.)

parasitized individuals at a glance. The tracheal system is conspicuous, the anterior branches ending in a pair of horn-like projections which later penetrate the scale of the host and extend to the outside, apparently for the purpose of supplying the parasite with air. On the dorso-posterior part of the larva appears a pair of curious claw-like hooks, which apparently aid the larva in its feeding by giving it a secure base from which to work with its powerful mouth-hooks. The larva now becomes opaque reddish within, due to the tissues of the host which are contained in its intestines.

THE PUPARIUM.

The pupa is enclosed within the hardened contracted larval skin which forms the puparium in which the transformation takes place.

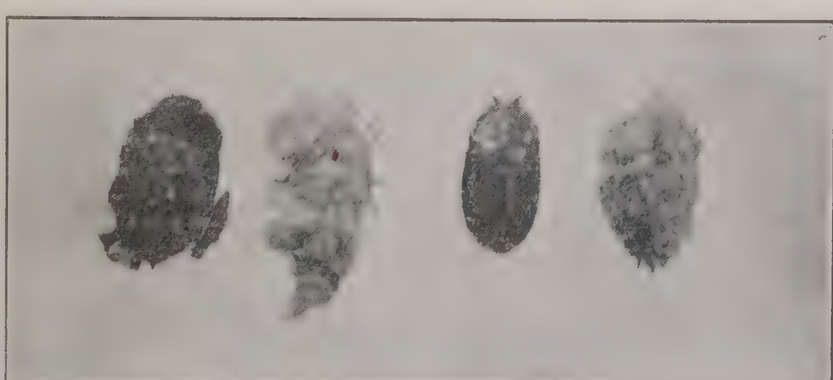


FIG. 136.—Puparia of Lestophonus. Enlarged. (Original.)

This is soft and yellowish at first, but soon hardens and changes to a reddish brown color. It is long oval, averaging 2 mm. in length and a little more than one-half that in width, tapering about equally at the two ends. Ten segments are readily visible, three of these being

included in the operculum which is shown anteriorly on the ventral surface as a flattened area. This is torn off when the fly escapes, leaving a large circular opening. The cephalic spiracles protrude over the front margin as two divergent horn-like structures, and the two dorso-posterior hooks described in the mature larva persist in the puparium. The long pair of tails also remains attached as in the mature larva. In the observed cases several days were required before the pupa formed inside the larval skin.

GENERATIONS PER YEAR.

There are apparently five or six generations of this parasite during the season, the number depending upon the climatic conditions.

QUARANTINE DIVISION.

FINIS RATIONEM EXCUSAT.

Report for the Month of August, 1916.

By Frederick Maskew.

During the past month, in addition to the regular routine work of the division, it was our fortune to be drafted on a committee appointed for the purpose of preparing a proposed amendment to the present horticultural laws, with a view to providing for a uniform system of intercepting, inspecting and treating all intercounty shipments of plant products for propagation at points of delivery in California. Heretofore our efforts along these lines have been entirely directed to imports of similar material seeking an entrance into the state from the outside world. Whatever measure of success we may have met with in this venture in the past we attribute more to the sanity, clarity and equity of the provisions of the state quarantine law, than to our own acumen in interpreting and putting the same into execution. Our experience—on the committee—in considering the new horizon, has been illuminating, and as a result we are still more convinced that the present state quarantine law, the statutory authority for our actions and which produces the findings recorded in this report each month, is a proper and complete instrument for the purpose for which it was enacted; that it should be held inviolate for that particular purpose and that its desirable and workable qualities should not be placed in jeopardy by any attempt to change, amend or make its provisions apply to domestic situations or contingencies.

SAN FRANCISCO STATION.

Steamship and baggage inspection:

Ships inspected	70
Passengers arriving from fruit fly ports	2,525

Horticultural imports:

	Parcels.
Passed as free from pests	85,333
Fumigated	1,508
Refused admittance	75
Contraband destroyed	30
Total parcels horticultural imports for the month	86,946

Pests Intercepted.

From Central America:

Lepidopterous larvæ in chili peppers.
Pseudococcus sp. on bananas.

From Florida:

Lecanium mangiferæ on mango.

From Hawaii:

Asterolecanium sp., *Coccus* sp. and *Chrysomphalus* sp. on Hibiscus and oleander cuttings.
Diaspis bromeliæ and *Pseudococcus bromeliæ* on pineapples.
Hemichionaspis minor and *Chysomphalus aonidum* on green cocoanuts.
Weevils in bean pods.

From Japan:

Aphis sp. on lotus plants.
Larvæ of borer, in dry plant roots.
Calandra oryzæ in riçe flour.
Mites in bulbs.

From New York:

Aphis sp. on chrysanthemums.

From Philadelphia:

Dialeurodes citri, Aphis sp. and *Pseudococcus* sp. on gardenias.

From Tahiti:

Lepidosaphes beckii on limes.

From Venezuela:

Isosoma orchidearum on orchids.

LOS ANGELES STATION.

Ships inspected	21	
Horticultural import:		Parcels.
Passed as free from pests		28,964
Fumigated		7
Refused admittance		4
Contraband destroyed		10
Total parcels horticultural imports for the month		28,985

Pests Intercepted.

From Central America:

Aspidiotus cydoniæ, Saissetia hemisphærica, Aspidiotus cyanophylli, Chrysomphalus scutiformis and *Pseudococcus* sp. on bananas.

From Mexico:

Chrysomphalus aonidum and *Chrysomphalus aurantii* on cocoanuts
Unidentified Lepidopterous larvæ and pupæ on unknown fruit.

From New Jersey:

Diaspis boisduvalii and *Coccus hesperidum* on orchids.

From Oregon:

Chrysomphalus aurantii on rubber tree.

SAN DIEGO STATION.

Steamship and baggage inspection:		
Ships inspected	33	
Fish boats inspected	38	
Passengers arriving from fruit fly ports	143	
Horticultural imports:		Parcels.
Passed as free from pests		1,972
Fumigated		5
Refused admittance		1
Contraband destroyed		36
Total parcels horticultural imports for the month		2,014

Pests Intercepted.

From Central America:

Aspidiotus cyanophylli and *Pseudococcus* sp. on bananas.

From Mexico:

Phthorimæa operculella in potatoes.
Chloridia obsoleta in corn.

From New York:

Diaspis boisduvalii and *Aspidiotus brittanicus* on orchids.

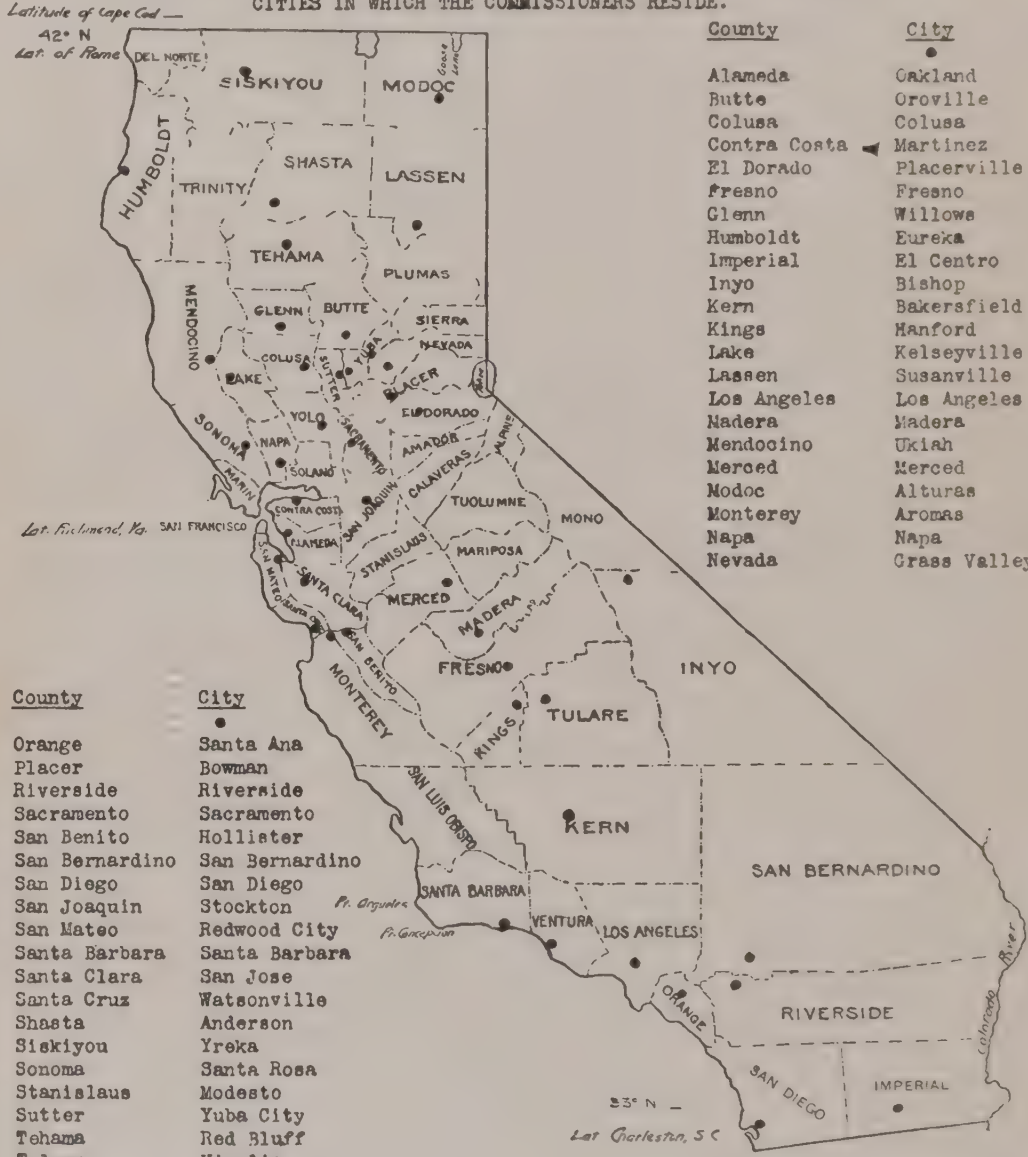
EUREKA STATION

Steamship and baggage inspection:		
Ships inspected	5	
Horticultural imports:		Parcels.
Passed as free from pests		3

SANTA BARBARA STATION.

(No Report.)

COUNTIES HAVING HORTICULTURAL COMMISSIONERS, WITH THE RESPECTIVE CITIES IN WHICH THE COMMISSIONERS RESIDE.



County	City ●
Alameda	Oakland
Butte	Oroville
Colusa	Colusa
Contra Costa	Martinez
El Dorado	Placerville
Fresno	Fresno
Glenn	Willows
Humboldt	Eureka
Imperial	El Centro
Inyo	Bishop
Kern	Bakersfield
Kings	Hanford
Lake	Kelseyville
Lassen	Susanville
Los Angeles	Los Angeles
Madera	Madera
Mendocino	Ukiah
Merced	Merced
Modoc	Alturas
Monterey	Aromas
Napa	Napa
Nevada	Grass Valley

County	City ●
Orange	Santa Ana
Placer	Bowman
Riverside	Riverside
Sacramento	Sacramento
San Benito	Hollister
San Bernardino	San Bernardino
San Diego	San Diego
San Joaquin	Stockton
San Mateo	Redwood City
Santa Barbara	Santa Barbara
Santa Clara	San Jose
Santa Cruz	Watsonville
Shasta	Anderson
Siskiyou	Yreka
Sonoma	Santa Rosa
Stanislaus	Modesto
Sutter	Yuba City
Tehama	Red Bluff
Tulare	Visalia
Ventura	Ventura
Yolo	Woodland
Yuba	Marysville

THE MONTHLY BULLETIN.

CALIFORNIA STATE COMMISSION OF HORTICULTURE

Vol. V. December, 1916. No. 12

PRELIMINARY OBSERVATIONS ON THE RIPENING OF BARTLETT PEARS.

By W. V. Cruess and P. M. Stone, Zymology Laboratory, University of California, Experiment Station, Berkeley.

Bartlett pears for shipment to Eastern markets are picked while still hard and green in order that they will not spoil in transit. The pears, if not picked too soon, ripen satisfactorily en route or after reaching their destination. There is, however, a minimum degree of ripeness below which the pears will not mature properly. In cooperation with the State Horticultural Commission, preliminary tests were made during the past season to ascertain if a simple chemical test could be used to determine when the fruit is ripe enough for shipping purposes. Unfortunately, the experiment was not started early enough in the season to obtain the results desired, but the data accumulated seem of sufficient interest to justify publication. In carrying out the tests during another season, the samples should be taken at least four to six weeks earlier than was the case during the past season.

PLAN.

One box samples of Bartlett pears were taken during the shipping season under the direction of the State Horticultural Commission in Sacramento, Placer and Contra Costa counties. These were shipped to the Zymology Laboratory and held at 20 degrees Centigrade or 68 degrees Fahrenheit until ripe. In addition to this routine method of ripening, a few lots were ripened under special conditions, some being placed in a refrigerator, some in an atmosphere of carbon dioxide, and others in a dessicator; the effects of temperature, carbon dioxide, and lack of air, respectively, upon the manner and rapidity of ripening being observed. Disappearance of starch was noted by halving the pears horizontally and longitudinally and applying a weak solution of iodin to the cut surface. As soon as the pears were received, the specific gravity and acid of the juice were obtained for comparison with similar data to be taken on the ripe and overripe pear juice later. Samples of the pulp of the green and ripe fruit were retained for further observation in respect to starch, sugar, and acid. The color, average size, and weight of the pears from each box were also noted.

OBSERVATIONS.

Daily observations were then made on the pears as to color, texture, flavor, starch, etc., and were recorded somewhat as follows:

TABLE I.

Sample No. 1 From Sacramento. Received July 1.

Date	Observations
July 1	Texture: very hard. Color: green. Flavor: no pear flavor; not sweet. Seeds: white. Size of pears: 2 3/16″ to 2 9/16″ in diameter. Analysis of juice: Specific gravity ---- 1.0470 Acid as malic ---- .341 Balling degree ---- 11.60 Average weight of pears: 5.1 oz. each.
July 3	Same in every respect as on July 1.
July 4	Same in every respect as on July 1.
July 5	Color has become a little lighter. Texture still hard. Starch test shows disappearance of starch around core but still gives starch test near outer edge; this indicates that the fruit ripens from the core outward.
July 6	About same as on July 5, but a little softer. Seems to be a little pear flavor developing.
July 7	Yellowish green color. Texture softer, but "gritty." Slight pear flavor. All but about outer 1/4″ to 3/8″ free from starch.
July 8	About same as on July 7.
July 10	Color light yellow. Texture moderately soft. Fairly ripe. Good pear flavor. Only small area at base of pears shows remaining starch with iodin test.
July 11	Fully ripe. Shows no remaining starch.
July 12	Aroma and flavor fully developed. Fully ripe. Analysis of juice: Specific gravity ---- 1.053 Balling degree of juice ---- 13.1 Acidity ---- .29
July 13	Flavor good but texture getting soft.
July 14	Very soft.
July 15	Very soft.
July 17	"Mushy"—too soft to eat. Specific gravity ---- 1.049 Balling ---- 12.1 Acid ---- .27
July 22	Turning brown. Specific gravity of juice ---- 1.047 Balling of juice ---- 11.6 Acid of juice ---- .21

The following table summarizes the data taken on the weights and diameters of the samples:

TABLE II.

Average Weights and Diameters of Samples.

Locality	Average weight in ounces	Average minimum diameter in inches	Average maximum diameter in inches	Total number of samples from each locality
Sacramento	5.88	2.37	2.81	12
Auburn	5.54	2.25	2.69	5
Martinez	5.44	2.34	2.72	5

TABLE III.

Observations on Balling, Acid, and Time to Ripen.

A. Pears from Sacramento.

Date received, 1916	Balling* when received	Acid when received	Balling when ripe	Acid when ripe	Balling when overripe	Acid when overripe	Days to ripen at 20° C. or 68° F.
July 1	11.60	.34	13.1	.29	11.6	.21	11
July 2	10.20	.27	11.6	.25	12.4	.22	11
July 10	11.00	.27	13.3	.33	12.8	.23	11
July 13	10.20	.27	13.1	.33	11.4	.26	13
July 19	11.39	.31	11.6	.32	----------	----------	12
July 24	11.90	.25	13.1	.32	----------	----------	9
July 27	12.10	.25	11.4	.31	----------	----------	9
July 31	----------	----------	13.3	.30	----------	----------	8
Aug. 3	12.10	.35	12.8	.35	----------	----------	9
Aug. 12	13.30	.35	14.7	.28	----------	----------	7
Aug. 14	14.00	.37	13.6	.23	----------	----------	----------
Aug. 17	14.50	.28	13.6	.34	----------	----------	10
Average	12.02	.30	12.93	.29	12.05	.23	10

Increase in Balling during ripening .91
Decrease in acid during ripening .01

B. Pears from Auburn.

July 7	14.3	.45	13.6	.33	15.0	.32	10
July 7	11.4	.41	14.3	.47	----------	----------	12
July 12	13.1	.43	14.7	.34	----------	----------	13
July 14	15.0	.43	15.2	.43	----------	----------	12
July 22	13.8	.37	15.2	.45	----------	----------	13
Average	13.52	.42	14.60	.40	----------	----------	12

Increase in Balling during ripening 1.08
Decrease in acid during ripening .02

C. Pears from Martinez.

July 8	11.9	.26	12.1	.24	12.6	.18	11
July 10	13.3	.32	13.5	.28	12.6	.19	10
July 18	12.8	.27	13.3	.30	----------	----------	12
July 22	12.8	.31	13.5	.28	----------	----------	10
July 26	13.3	.26	14.0	.35	----------	----------	12
Average	12.8	.29	13.3	.29	12.6	.185	11

Increase in Balling during ripening [illegible]
Increase in acid during ripening .00

*Balling means the per cent of sugar, etc., in the juice, and is determined in the same way that the "sugar test" is made in grape juice. (See the Monthly Bulletin for August, 1916, pp. 293-296.)

General quality as affected by date of picking.

The first pears from Martinez on July 8 retained an astringent taste after ripening. The succeeding samples developed agreeable flavors and aromas, indicating that the first sample was near the minimum degree of ripeness.

The samples from all three localities developed a more agreeable flavor and aroma as the season progressed, those gathered near the end of the season being of considerably better quality than those at the beginning of the series. The texture of the last samples was perceptibly coarser than that of pears gathered earlier in the season.

Comparison of tree ripened and artificially ripened pears.

The commonly recognized fact that the quality of pears ripened off the tree is superior to that of tree ripened fruit was noted. The tree ripened fruit was coarser in texture than the artificially ripened pears and the flavor and aroma were more pronounced.

Effect of locality on composition.

The pears from Auburn contained more sugar than those from Sacramento or Martinez; the Sacramento pears were lower than those from the other two localities in this constituent. The average Balling and acid of the samples as received were as follows. It will be noted that the differences in composition are not great.

Locality	Average Balling when received	Average acid when received
Sacramento	12.02	.30
Auburn	13.52	.42
Martinez	12.80	.29

Effect of temperature.

Pears were stored at 20 degrees Centigrade and in an ice chest, respectively. The pears at 20 degrees Centigrade ripened in thirteen days; those in the refrigerator, in twenty-one days. The quality of the pears after ripening was good in both instances.

Effect of air.

Pears stored in air at room temperature ripened in ten days. Pears from the same lot stored in carbon dioxide showed practically no ripening after two months storage at room temperature. Pears stored in a closed dessicator ripened very slightly in two weeks; in this case, the supply of air was small. These tests indicate that oxygen is necessary for pear ripening. This point is interesting both from the chemical and practical standpoints and merits further investigation.

Changes in Balling and acid during ripening.

There was a slight increase in Balling, .5 to 1.08 per cent, during artificial ripening of pears, and practically no change in acid.

Disappearance of starch.

Iodin tests applied to freshly cut halves during ripening indicated disappearance as the pear became ripe. The disappearance was gradual and not complete until the pears were practically ripe. The starch disappeared more rapidly from the region around the core than it did from the outer portion of the fruit.

Effect of date of picking on starch test.

Pears picked at end of the tests gave practically as strong a starch reaction with iodin as did those picked at the beginning of the season. Therefore this criterion can not be used in judging ripeness.

SUMMARY.

1. Relation of Balling and acid to suitability of pears for shipping purposes.

The pears picked on or after July 1, with one exception, ripened very satisfactorily, although the fruit near the end of the season developed more satisfactorily as regards flavor and aroma than that at the beginning of the season. The sample which did not develop satisfactorily was 11.9 Balling and .26 per cent acid, a composition not differing greatly from that of pears which ripened satisfactorily.

The tests should be started earlier in the season to obtain results of more value on the above point. The Balling and acid tests or a starch test by iodin do not seem to be of much value in judging the proper stage of maturity to pick pears for shipment.

2. Increase in Balling of pears on tree during period of tests.

The Balling degree increased between the first and last samples as follows: Sacramento pears, 2.9 per cent; Auburn, .5 per cent; Martinez, 1.4 per cent. The length of time represented is three to six weeks. The rate of increase is slow, and it is very doubtful if this test will prove of much value.

3. Size.

Probably a minimum size will be of more value than a chemical test in deciding the time of picking. Pears used in the above tests averaged from 2.25 to 2.81 inches in diameter and 5.69 ounces in weight. From the data at hand it seems safe to say that pears of this or greater weight will ripen satisfactorily. For estimation of the size of the pears, probably either the diameter or weight could be used as a criterion. The diameter can, however, be more quickly obtained than the weight.

SUGGESTIONS.

1. Determine whether there is any relation between the size of pear and suitability for shipping purposes.
2. Determine whether there is any relation between the specific gravity of pears, as determined by floating in salt solutions of different specific gravities, and the suitability for shipping purposes.
3. Determine whether there is any relation between "coarseness of grain" of pulp or color of seeds and suitability for shipping purposes.

THE IMPROVEMENT OF NURSERY STOCK.*

By A. L. Wisker, Loma Rica Nursery, Grass Valley, California.

Among the several subjects that are of practical importance to the orchardist today, the improvement of nursery stock is one that never fails to interest both the man who plants the tree or vine and the man who propagates it. On the proposition that the improvement of nursery stock is in every sense desirable, if we are to progress toward perfection in our horticultural endeavors, orchardist and nurseryman alike find at least one point upon which they are in complete accord.

While the orchardist can, and does, directly contribute toward this improvement his opportunities are to some degree limited, and it is rarely that he actually calls into existence a new variety or improves an old one. His contribution to our progress must largely consist in observing the behavior of the hundreds of thousands of seedlings, and the mutations and bud-sports—Nature's own chance-children—that are continually coming under his notice. In the past most of our acquisitions in the way of new varieties may be credited to observant orchardists the world over, and while these men were often humble and obscure they have placed us in their everlasting debt.

In these latter years another class of men has added immeasurably to our horticultural wealth. These are the plant breeders, who, with more or less definite plan and an intelligent purpose, have scored a remarkable advance over Mother Nature's haphazard ways of plant improvement. We here find the names of such men as Hansen, Munson, Burbank, Etter, Sharpe and others, all of whom command our admiration when we contemplate their patient industry and perseverance.

Still another factor in the improvement of our orchards and nurseries has been the work of both scientific and lay investigators in assembling from the far corners of the earth desirable varieties and new species. To such institutions as the Arnold Arboretum and to such men as Gillet, Rock, Roeding, Meyer and Coates, we owe much for accomplishments in this direction.

Of no less importance is the progress made by that body of scientists attached to the Department of Agriculture and to the several state universities and experiment stations. These men now have under way many experiments dealing with such matters as improvements in root-stocks, designed to meet every condition of soil, moisture and the underground attacks of insects and plant diseases. Naturally such experiments must usually be carried on for a considerable period before wholly conclusive results are accomplished. One of these experiments

*Address before the Forty-Ninth State Fruit Growers Convention, Napa, Cal., November, 1916.

NOTE.—In view of the fact that the subject of proper root stocks for our fruit trees is of so great importance, we are publishing this exceedingly interesting article by Mr. A. L. Wisker, of Grass Valley, who has long been identified with those progressive nurserymen and fruit growers who have been endeavoring to accomplish something in this field of research. The members of the fruit growers' convention which was recently held in Napa recognizing the necessity of further investigation passed a resolution asking the State Commissioner of Horticulture to appoint a committee of five to take up the matter of importing root stocks with the United States Department of Agriculture and the University of California. In accordance with this resolution I have appointed the following committee: C. W. Beers, A. L. Wisker, B. B. Meek, James Mills and Harry P. Stabler.—G. H. HECKE.

that has been in progress long enough to permit definite conclusions is that of the Southern Oregon Experiment Station, where Professor Reimer has been working for some years with many species of pears in an endeavor to find a stock that would be free from the disadvantages of the French seedling.

As is well known to most orchardists, the French root is subject to great injury from attacks of the pear-root aphis and is particularly susceptible to pear blight. As it suckers readily and these suckers often carry blight to the underground parts of the tree, the use of the French root not only adds to any system of blight control the heavy expense of eradicating blight from the root, but it at the same time constitutes an added and needless menace to the life of the tree.

Reimer's work has been most systematic and has demonstrated that great improvement in nursery stock will result from discarding the French seedling and substituting the Japanese or Chinese seedling, sometimes called the sand pear. For years this was known to botanists as "*Pyrus sinensis,*" but Rehder, of the Arnold Arboretum, has recently determined that "*Pyrus serotina*" is the correct name of the species generally used by nurserymen under the names "Japan seedling" or "Chinese seedling." This species is quite resistant to attacks of the woolly aphis of the pear and remarkably resistant to blight. Reimer repeatedly inoculated the roots of this species with blight without producing a single case of the disease. At the same time he made similar inoculations with the same culture in the roots of French seedlings in adjoining rows, killing 100 per cent with blight.

This species produces a tree of great vigor when used as a stock for our commercial varieties and makes a perfect union. Although in satisfactory use in the eastern and southern states for over fifty years its use on the Pacific Coast dates back less than ten, but its desirable qualities are now so generally recognized here that it appears destined to supplant the French root within a short time. Harry Nicholson, a Tennessee nurseryman, is now using the Japan root in an experimental way as a stock for apples, to obtain a root that will not be injured by the woolly apple aphis—a pest that makes apple growing impractical in some nurseries.

Nurserymen will welcome the discovery of a stock for apples that is aphis-proof and which will avoid the cumbersome method, now practiced to a slight degree, of double-working on Northern Spy, a variety somewhat resistant to aphis.

Plum growers realize that there is much room for improvement in the stocks now in use for this fruit. Myrobalan, the stock usually used for moist soils, is very susceptible to crown gall. The same is true of the peach root, which is generally used in dry soils. Peach root has the further disadvantage of making a most unsatisfactory union with many plums, among them being Diamond, Grand Duke, Yellow Egg, Robe de Sargent, and Sugar. A stock for plums that will give as good results on dry soils as the peach, that will make as good a union with all varieties as Myrobalan, and that will be as free from crown gall as the Damson, without its tendency to sucker, would be of greatest advantage to plum growers. Leonard Coates has been experimenting with several new plum stocks, and as he is already responsible for the introduction of a number of valuable varieties of different fruits, and

for the selection and propagation of certain desirable strains of other varieties already known, it will only be in keeping with his past achievements if he should score another improvement in this direction.

A seedling peach from China, now the subject of an experiment by the Bureau of Plant Industry at the Chico station, promises a stock that is remarkably resistant to alkali. If present expectations are realized it is probable that peaches, apricots, nectarines, plums and almonds can be worked on this root and grown on soils now wholly unsuited to their culture.

An interesting field for the improvement of nursery stock has been opened up during the past few years by the work of various investigators in propagating from selected strains within any given variety. Shamel's work with citrus fruits is an example with which all Californians are familiar. Authorities on plant-breeding recognize the occasional occurrence of mutations or bud-sports within a variety that lead to some modification of type characteristics. These modifications may be so slight as not to be easily recognized as a departure from the original type, or they may in truth constitute a sub-variety that represents a regrouping of varietal traits sufficiently striking to represent a marked improvement on the original type. Probably many of our so-called ''improved'' strains of certain varieties are merely bud-sports closely resembling the parent type.

The propagation of trees from these mutations is one of the sources for the improvement of nursery stock that is not yet fully appreciated, and both nurserymen and orchardists should give greater attention to the recognition of desirable bud-variants. At the same time, nurserymen must recognize the fact that bud-sports are as apt to occur in the descending as in the ascending scale, and should be extremely careful to take wood for budding or grafting from trees that show the desirable characteristics of the variety to be propagated. In deciduous fruits there seems to be less of a tendency toward reversion to a less desirable type than in citrus, but probably the general principle holds good with both that an appreciable improvement in nursery stock will result from careful bud selection.

However, it is probable that the hereditary influence of bud selection merely creates a tendency toward certain results, and that this tendency may be wholly nullified by unfavorable environment, at least so far as color, size, or fruitfulness is concerned. These characteristics are variable, often changing in the same tree from year to year, and are so dependent upon climate, moisture, culture, plant food, and pollination that it is wholly unlikely that they can be controlled by any improvement or lack of improvement in nursery stock, although it is reasonable to believe under similar conditions better results will be obtained in the orchard from nursery stock propagated from trees representative of the best strains of any given variety.

Although many of the best horticultural authorities of the nation do not accept the theory that trees can be ''pedigreed'' in the same sense as live stock, the evidence is certainly sufficient to indicate that careful selection of budwood on the part of the nurseryman is a wholly desirable practice. In connection with a selection of the best rootstocks

available, it represents his most important contribution to the improvement of nursery stock, since he is essentially a propagator and disseminator but rarely the creator or even the discoverer of improved varieties.

In order that nursery stock may be improved in the broadest sense of the word, the orchardist must be continually on the alert to observe all that is desirable among Nature's raw materials—the chance seedlings and bud-sports; the plant breeder must take the most desirable traits from the best we have in each fruit and endeavor to combine them; the scientific investigators of our experiment stations must enter the practically neglected field of rootstock investigation and determine, not only the affinity between stock and cion, but the root that is best adapted to certain soil conditions and best adapted to resist insect pests and plant diseases; while the nurseryman, profiting by all that these have done, must get out of the rut of blind and thoughtless following of old horticultural trails that have naught but antiquity to recommend them, and he must fully understand the great responsibility resting upon him as counsellor and guide to many orchardists. He should never forget the cruel disappointment to someone that must inevitably follow either his carelessness or his dishonesty if he should allow stock to leave his hands other than that which his customer desires. He must place his business on a higher plane than that of mere buying and selling and must feel that it is his mission to be an agent in helping Nature add to the welfare of mankind.

With this fourfold force in intelligent cooperation the improvement of nursery stock will be greater than we can at this time imagine, and its effect upon horticultural development will be so far-reaching that we can not even attempt to estimate the results.

OPPORTUNITIES FOR PROFIT IN HORTICULTURE.

By Myrtle Shepherd Francis, Ventura, Cal.

Do not think that the word "profit" in the title of this paper means wealth, for if you are to receive any message from me, it must come from my enthusiasm, my love for my work, and not from my ability to accumulate money. There is no "get rich quick scheme" in horticulture for men or for women, and while it is my hope that all women who walk the flowery or thorny pathway of horticulture may have a wide margin of financial profits, I hope, too, that they will realize that there are other than pecuniary profits; that health of mind and body, the joy of blue sky and fresh air, the feel of the good brown earth to your body, the insight into the many forms of life heretofore unknown, the friendships otherwise impossible and the freedom from conventionality will aid them if, at the end of the year, the margin narrows down and they find that expenses have eaten away the hoped-for balance.

All sorts of problems confront us today, and women who have been reaching out for political responsibilities must not shrink from the physical labor that these responsibilities carry with them. For, with all of these movements of "Back to the Land" comes the necessity for the labor of women as well as men, and the time is not far distant when a woman will drive her traction engine as easily as she drives her auto today, nor will she feel it a greater hardship to hoe and spade than to wash or scrub. Will this woman be an American woman?

California offers greater opportunities for women who wish to pursue horticulture as a means of earning a livelihood than other states. We are entering into a new era; our great Panama Canal is open, suffrage has put women on an equal footing politically with her brothers and the same opportunities are offered to her that are offered to them, with the same hardships, responsibilities and risks that they have, plus home, children and lack of business experience, quite often, to hamper her.

What are some of these opportunities that horticulture offers women? Wholesale seed and plant growing, nursery stock, vegetables, small fruits, cut flowers, decorative work, nature study classes, garden supervision, teaching botany, teaching school gardening, landscape gardening, hybridizing, plant pathology, and general farming; above all is the opportunity to labor.

One of the most alluring of these occupations, and one that women, by their finely developed senses, should be eminently fitted for, is landscape gardening. It is a field almost untrod by them, and California gardening as an art is yet in its infancy, so the women who choose this profession have opportunities undreamed of for pleasure and profit.

California is entering into a new era in more ways than one. The enormous acreage of cultivated land, the great number of imported plants, the climate so conducive to the growth of the higher forms of plant life and also to the "rapid transit" of the lower forms has confronted the growers with all sorts of problems.

There is comparatively little knowledge regarding the diseases that every plant is host to. Speaking of this need not long ago to a prominent plant pathologist, he answered that there are not enough young

men willing to give the requisite amount of time necessary to work out these problems. After years of study there is not great compensation, except in the results, attached to positions of this kind, which are almost all governmental; yet men make a living by them, so why could not women?

The day is not far distant when the private garden will be as regularly inspected and treated as the orchard. Why should not women do some of this work? As yet many of the subordinate inspectors are not graduates of an agricultural college.

The laboratory holds out much more to interest and inspire, and women have already distinguished themselves along these lines: Miss Charles of the Agricultural Department at Washington, D. C., is the expert on fungous diseases, and Miss Elizabeth Smith of the University of California is well known for her original work.

Plant pathology is but one of the many ramifications of laboratory work. Have you ever stopped to think whence comes this perfume—what makes the violet blue—what causes doubleness in certain flowers? Do you know that you might be the one to find out, if you cared enough about it? Two English women are working on the problems of color and doubleness—Miss Muriel Wheldale and Miss Edith Saunders of Cambridge. Think of it! Could anything be more poetical than to discover what causes that velvety red color in the petal of a rose? No, it would be like any other laboratory work, messing with test tubes and retorts, in a big apron, and thinking, thinking, thinking.

Many women have been successful in decorative work, which can often be combined with some other business, and if one has taste, and above all originality, she could build up a good business in any town of four or five thousand inhabitants.

What is this mysterious operation called hybridizing, which in its wider sense is known as plant-breeding? Simply this, man reaching out to assist Nature in her evolution of the vegetable kingdom to a more useful and beautiful existence. The woman who enters this field should prepare herself for it by a college course, if possible; if not, there are books to be studied again and yet again. Botany, of course, as a foundation, then Darwin, Bailey, De Vries, Bateson, Punnett and many others. Novels will cease to allure when once one becomes interested in this fascinating work. All the world and his wife may go by but her eyes will be fixed in the heart of a flower.

When we stop to think of all the marvelously beautiful cultivated plants we wonder if there can possibly be room for improvement, but here is where imagination soars and if your soul is receptive Nature will whisper in your ear, and out of the Infinite, flower forms will float before you, an ideal will be fixed in your mind and a determination to realize this ideal, for in the floral kingdom ideals may be realized.

Women with but small gardens may experiment and who knows what the results may be? Dr. De Vries in his "Species and Varieties" encourages the owners of small places to be ever on the alert for mutations that occasionally occur and may be of great benefit or beauty to mankind. But they must remember that they are entering into a partnership with Nature, that experiments are costly and that success comes only with a high ideal, patience and labor. They will gain only what they give their work. If they put capital and good business judgment

into it, they will reap the rewards that accrue from them. If they put love of their work, enthusiasm, perseverance, faith in their ability to overcome their difficulties, they will reap the rewards these qualities give a thousandfold. From every direction hands will be reached out to help, unthought-of friendships will be formed, undreamed-of opportunities for work and more work and the realization will come that in this, above all other occupations, it is the work that is important and not the worker.

But I hear some one say: "You have not told how to make money in these delightful occupations." No, that is the individual woman's problem; no one can tell her how to make money, it is something inherent in the woman herself. The woman who has that power will not ask how nor will she go to the successful woman and ask her what to grow, where she markets her crops, what are her prices, and where to go into business; she will see her opportunity and grasp it.

So many women are still living in the pattern-borrowing and recipe-exchanging age and still so ignorant of the ethics of business that it never occurs to them that it is not just as legitimate to ask another woman about her business affairs as to ask her whether she sets her bread with potato or compressed yeast.

Before going into any branch of horticulture a woman should know her own capabilities. She should know the needs of her locality and not try to make people who want cabbages buy roses, even though the roses do please her esthetic taste and cabbages offend it. When she has successfully filled the need for cabbages she may try the roses as an experiment, but experiments are often disastrous affairs and it is just such experiences that discourage and dishearten women. They do not realize that their failures are generally due to lack of business experience and judgment.

Where are these opportunities? That is another question that women must answer for themselves. Before they can succeed they must learn to depend upon themselves.

Women who go into horticulture can gain wealth and distinction in one way only: by using the same methods men do who are successful and giving the best the markets demand, whether it be a plan for a city garden, a bouquet of orchids, or a crop of onions. The day is past when we say: "That is well done—for a woman." Admitting that they are handicapped in many ways they have just that much greater opportunity of proving what they are by the manner in which they overcome their difficulties.

In this partnership with Nature are many disappointments in store, and from the depths of our hearts we are often ready to believe her the proverbial stepmother. She who enters this partnership must be a philosopher indeed, for one constantly has to cope with conditions over which one has no control. Unexpected winds, heat, cold, floods, combine to reduce the profits each season, while fungi, bugs, thrips, worms and scales of every description tend to destroy all illusions one ever had as to the kindliness of Mother Nature until the woman who has never had to cope with her is ready to cry hysterically: "Hail to the dishpan, the mop, and the broom; me for the city flat, the typewriter, the telephone!" So here is the grand opportunity to acquire a chastened spirit and a contrite heart.

Doubtless some of you will be disappointed that no definite statement concerning the financial profits of horticultural occupations has been given in this paper and that there is more to discourage than to encourage women from going into them. While I have the utmost sympathy for women who wish to lead out-of-door lives, I wish to emphasize the fact that there is no "light work and easy money" in any of them. Like other businesses a living can be made, and from small beginnings wealth is sometimes attained, but that is due to the individual rather than to the occupation. The main difficulty, as in all other lines, is disposing of the products, whether they be cut flowers, seeds or professional services that are to be disposed of. I wish, too, to emphasize that it is originality that counts. Try to do something that but few are doing and that you feel you can excel in.

This paper would be unfinished did I not cite the experiences of one woman whose life has been my chief inspiration. She was a housekeeper, little children clung to her skirts, poverty stared her in the face, ill health dogged her footsteps, her only assets were boundless enthusiasm, dauntless courage, an overwhelming love of plants and an abiding confidence in herself. She was almost forty when she began her work and at her death, twenty-five years later, she was known in two continents. I refer to my mother, the late Theodosia B. Shepherd. It may be that you, too, are a housekeeper, that little children cling to your skirts, and that it is necessary for you to assist in making the living, too, just so can you adjust outside work with that inside if the call is strong enough. You, too, may labor in the burning sun, in cold winds and damp fogs, with soiled clothing and a tired body; you will have sorrows, malice and envy seek to destroy you, friends prove faithless, disappointments rend your heart; but through it all like Chanticleer, you, too, will have your work. So if your soul cries out to be free from the pettiness of daily life, if you long for the blue sky above and the brown earth beneath your feet and the flutter of a little flower calls you, slip your hand in that of the Infinite Teacher and follow on.

THE MONTHLY BULLETIN

CALIFORNIA STATE COMMISSION OF HORTICULTURE.

DEVOTED TO HORTICULTURE IN ITS BROADEST SENSE, WITH SPECIAL REFERENCE TO PLANT DISEASES, INSECT PESTS, AND THEIR CONTROL.

Sent free to all citizens of the State of California. Offered in exchange for bulletins of the Federal Government and experiment stations, entomological and mycological journals, agricultural and horticultural papers, botanical and other publications of a similar nature.

Entered as second class matter December 29, 1911, at the post office at Sacramento, California, under the act of June 6, 1900.

The State Plant Board of Florida has recently issued a quarterly bulletin which we believe will meet with the same appreciation by Florida fruit growers as the fruit growers of the state of California have shown the *Monthly Bulletin*. If the editor of this publication continues to serve his readers with the good things he has given in the first issue there will be no question of its success. It is with considerable pride and gratification that we are reprinting herewith a paragraph taken from this quarterly bulletin. We hope that we have made our publication of value as the editor of the Florida Bulletin says we have. It will be our constant effort to keep this publication on a practical scientific basis.

> "*The Quarterly Bulletin.* In presenting this, the first number of the "Bulletin," to the farmers and growers of Florida, we frankly confess to having modeled it after that most excellent journal, "The Monthly Bulletin," published by the California State Commission of Horticulture.
>
> "For nearly five years the Monthly Bulletin has carried its messages to the fruit growers and citizens of California, keeping them informed regarding the latest horticultural methods, the best means of fighting insect pests and diseases and current information regarding the efficient quarantine system which has kept so many destructive insects and plant diseases out of that state. Its numbers are in demand wherever fruit is grown, both in the United States and foreign countries, and it has attained the enviable position of being one of the foremost publications devoted to the practical application of scientific knowledge. In launching a Florida publication intended to serve a somewhat similar purpose we have elected to follow a good example rather than to try experiments in the—to us—uncharted sea of 'journalism.'"

The Chestnut Bark Disease.—From various reliable sources information has come to the California State Commissioner of Horticulture that the eastern chestnut-growing districts are seriously afflicted with

the chestnut "blight" or bark disease, which usually results in the total destruction of the chestnut groves located in these districts. The constantly diminishing supply of the edible chestnut has increased the price to $10 per bushel in the New York market.

In view of the fact that large areas of California foothill lands are particularly adapted to the cultivation of the chestnut, as indicated by the remarkable health and bearing qualities of isolated trees, the state commissioner has started an inquiry through the United States Department of Agriculture to determine the exact area through which the disease has spread so far. A particularly virulent attack of the blight is reported from Pennsylvania, Maryland, West Virginia and Virginia, and it is extending rapidly northward through the New England states as far as the chestnut will grow.

The following regulations and instructions have been sent to the county horticultural commissioners, as quarantine guardians of the state, for the purpose of calling their attention to this deadly disease, in order that they may be on their guard and be especially careful in the examination of any chestnut trees arriving in shipments of nursery stock from the East.

STATE OF CALIFORNIA
COMMISSION OF HORTICULTURE.

QUARANTINE REGULATION NO. 6.

Chestnut Bark Disease.

The fact has been determined by the State Commissioner of Horticulture that a virulent disease of chestnut trees known as Chestnut Bark Disease (*Endothia parasitica* Murr.), new to and not known to exist in the state of California, is widely distributed in several states of the United States, and that this disease can readily be transported on nursery stock.

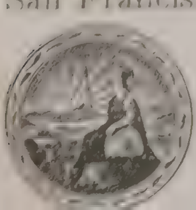
Therefore, all state quarantine guardians are hereby urged to be especially diligent in examining chestnut trees imported into the state of California.

The following description taken from the Year Book of the Department of Agriculture for 1912 is here quoted for guidance at time of making inspection of imported chestnut trees:

> "Nursery trees affected by the bark disease rarely show it prominently at the time when they are shipped; the threads of conidia or the yellow or orange pustules are rarely present, and usually all the inspector can find is a small, slightly depressed, dark-colored area of dead bark, usually near the ground, which is easily overlooked or mistaken for some insignificant injury. Upon cutting into such a spot the inner bark shows a most characteristic disorganized "punky" appearance quite different from that of any other bark injury. Occasionally a yellowish brown or reddish band or blotch, either girdling or partly girdling the young tree, may be seen, which is very characteristic."

All state quarantine guardians are hereby requested to segregate and hold any and all chestnut trees showing symptoms as described above, and forward samples in tight containers to the Quarantine Office at San Francisco for determination.

(Signed) G. H. HECKE,
State Commissioner of Horticulture.



Issued December 4, 1916. —G. H. H.

The Sugar Beet Leaf-hopper.—Not many people in California realize that in the insect which forms the subject of this paragraph we have a pest which is one of the greatest drains upon our agricultural industry. In the single season of 1914 one beet company experienced a total loss of 7,000 acres of beets and a partial loss on several thousand more, a loss which, computed in money value, amounted to $1,000,000. While the leaf-hopper has reached its greatest destructiveness in the Salinas Valley, it is pretty generally distributed through the northern part of the state and during the season just passed became alarmingly abundant in the lower San Joaquin Valley. The beet growers have suffered in silence, probably because most of them do not yet fully appreciate the fact that the curly-top disease is disseminated by this insect. The United States Department of Agriculture and the University of California are both at the present time actively engaged in a study of this pest, but its control presents unusual difficulties. In a problem so serious we should leave no stone unturned to obtain relief, and here the question arises in regard to parasites and predaceous enemies. While from the nature of things native insects are not as susceptible of control by this means as are the introduced pests, still there are possibilities in this direction which should be taken advantage of, especially in the introduction of natural enemies of related leaf-hoppers. With the idea in mind of ascertaining what the commission can do in this line for the beet grower, the writer, in company with Mr. Smith of the Insectary, has arranged for a meeting in the Salinas Valley early in December.—G. H. H.

The Sicilian Mealybug Parasite at Marysville.—On January 21, 1916, we liberated a small colony of 500 specimens of Paraleptomastix at Marysville under conditions which were only fair for its establishment. On November 28th an investigation was made of this colony, and somewhat to our surprise and very much to our gratification it was found that the parasite had already thoroughly established itself. Many of the mummified mealybugs were found on the leaves of the infested oleander and these after being placed in a breeding cage in the Insectary produced numerous adults of the parasite. This is the northern limit of the introduction so far, but it already proves that the parasite is well adapted to our coldest citrus regions as well as to those regions which have the hottest and driest summer months. This is more than can be said of many of the introductions into California, most of which thrived along the coast but failed inland. The past summer was fully as hot as, and drier than, the normal, and the colony has already passed through two freezes. The adaptability of this parasite to our climate seems to be all that could be desired.—H. S. S.

The Forty-ninth Fruit Growers' Convention at Napa.—Everyone who attended the Napa convention seemed pleased, and a great many remarked that it was the best convention that has been held in recent years. From the standpoint of attendance it was above the average fruit growers' convention, but still the program was one that should have drawn a crowd five times as large.

Commenting upon the attendance, Editor C. B. Messenger of the California Cultivator, states, "It was of the best so far as fruit growers' conventions go, but in no sense equal to attendance at the

Fig. [illegible].—A few of the fruit growers in attendance at their Forty-ninth annual convention which was held at Napa in November. (Photo by Weldon.)

FIG. 139.—Parade of tractors at the Forty-ninth State Fruit Growers' Convention. (Photo by Weldon.)

movies." We have no way of telling how many people directly interested in fruit growing attended the movies instead of the convention, but we do know there were hundreds of fruit growers in Napa and the adjoining counties, who did not attend, who would have been benefited had they heard the papers and discussions relating to their business. We believe also that people not directly interested in farming would be benefited from lectures by such men as Weinstock, Hunt, Mead and McKevitt. So we believe there is much food for thought in the statement which Mr. Messenger makes, and which means that people would rather pay something to be entertained with things foreign to their business, than to listen to a carefully prepared lecture on the things that would help them in their business.

Notwithstanding this criticism of fruit growers' conventions in general, it is a fact that many of the best men in the orchard business attend and benefit through the knowledge gained, and it is hoped that indirectly such benefits are shared by the majority of the fruit growers.

The tractor demonstration proved a drawing card, and was of much real practical value. Napa County fruit growers are interested in orchard tractors, and those who witnessed the demonstrations by the different makes were not there out of mere curiosity, but because they expected to purchase tractors, which are rapidly becoming a necessary part of orchard machinery.—G. P. W.

Amendment to Quarantine Order No. 28.—The following amendment has been made to Quarantine Order No. 28:

STATE OF CALIFORNIA
STATE COMMISSION OF HORTICULTURE.

AMENDMENT NO. 1 TO QUARANTINE ORDER NO. 28.

Citrus Canker.

The fact has been determined by the State Commissioner of Horticulture, that the state of Arizona has declared and is maintaining a quarantine against the entrance into the state of Arizona of all host fruits and host plants of the citrus canker, *Pseudomonas citri,* and that the citrus canker does not exist in the state of Arizona.

Therefore it is declared that until further orders the state of Arizona is exempted from the regulations of Quarantine Order No. 28.

Quarantine Order No. 28 is amended accordingly.

G. H. HECKE,
State Commissioner of Horticulture.

Approved November 28, 1916:
HIRAM W. JOHNSON,
Governor of the State of California.

The Eight to One Test in Fresno County.—The enforcement of the eight to one standard law on oranges, passed by the board of supervisitors in Fresno County last October, like the enforcement of the grape standardization law, has shown that a certain amount of green and unfit fruit has been shipped out of California. The inspectors are required to turn down fruit every day that would undoubtedly be shipped if inspection were not conducted. In nearly every case the shippers made no protest when condemnation took place, admitting that condemnations were necessary.

Nevertheless, the writer finds the eight to one test, as applied to oranges in Fresno County, unsatisfactory for the following general reasons: There are varieties of oranges that will not reach the eight to one standard. The acreage of these varieties is not large, but the growers should not be absolutely prevented from shipping until their trees are grafted over to sweet varieties. Some localities do not produce fruit that is sweet enough to reach the eight to one test, and at the same time the oranges will be well colored, and apparently mature. This condition is possibly due to lack of cultivation or other unfavorable conditions.

The one month and a half campaign with the eight to one test in Fresno County was such as to cause the writer to believe more strongly in the standardization of fruits, and it emphasized the need of educating the growers in standardization, and to the necessity of packing, honestly, only fruit that is fit for consumption.—Fred P. Roullard.

REPORT OF COMMITTEE ON RESOLUTIONS, FORTY-NINTH STATE FRUIT GROWERS' CONVENTION.

Be it resolved, That this convention extend its heartfelt thanks and appreciation to the efficient and courteous Horticultural Commissioner of Napa County, J. J. Fox, for his untiring efforts to make our stay both profitable and interesting.

To the Napa Chamber of Commerce for its progressive spirit and use of its splendid building and especially to its courteous and helpful president, Mr. Frank L. Hunt, whose efforts have materially added to the success of this gathering.

To the citizens of Napa who have thrown open their comfortable homes that we, their state-wide guests, might be entertained in comfort and with satisfaction.

To the many manufacturers and agents of farm machinery whose splendid demonstrations have done so much to make this convention valuable and instructive, and

To all of us who have so cordially contributed to the splendid success of this convention now closing.

WHEREAS, The State Commissioner of Horticulture, the Honorable G. H. Hecke, has shown a deep and comprehensive grasp of the horticultural needs of the state; therefore

Be it resolved, That we express our appreciation of his endeavors to improve and foster the varied branches of the interests involved and pledge to him our cordial and liberal support in his laudable efforts.

WHEREAS, The Central Stockmen's Association of California, in convention assembled at Coalinga, California, November 4, 1916, passed the following resolution; and

WHEREAS, The modification of the law contemplated in this resolution will be advantageous to the members of the California State Fruit Growers' Association; and

WHEREAS, A bill will be introduced at the next session of the legislature of the state of California providing that all promissory notes secured by chattel mortgages shall be negotiable instruments; be it

Resolved, That this association favors the passage of a bill making notes secured by chattel mortgage negotiable provided this can be done in a practical way.

WHEREAS, The acreage of prunes and apricots coming into bearing in California is unprecedentedly great; and

WHEREAS, We realize that only through a comprehensive organization of the growers can the dried fruit markets of the world be exploited in the interests of the growers; therefore be it

Resolved, That this convention hereby endorses the principle of the formation of the cooperative organization of the prune and apricot growers for the purpose of marketing their products to the best possible advantage to the growers.

WHEREAS, The beet leaf-hopper is present in the sugar beet fields of California; and

WHEREAS, This insect pest is of such a serious nature that in one section alone of California a crop loss of approximately one million dollars was sustained in 1914 due to its ravages; and

WHEREAS, There is no known artificial remedy for the control of this pest; and

WHEREAS, The introduction of natural parasite enemies seems to offer the only relief to the sugar beet growers of this state; and

WHEREAS, The sugar cane leaf-hopper of Hawaii has been successfully controlled by the introduction of parasites; therefore be it

Resolved, That the fruit growers assembled in convention at Napa lend their influence toward securing an appropriation during the next legislative session for

the purpose of sending a collector to foreign countries to search for beneficial insects to aid in the control of this important pest, the direction of this work to be entrusted to the State Commissioner of Horticulture.

WHEREAS, California's most important industry is the production of fruit and fruit products—fresh, canned and dried—it needs certain help from the state.

We, the fruit growers of California, call attention to the advisability of there being established at Davis a fruit products laboratory and demonstration plant—to be equipped with appliances for investigation and improvement of present methods, and with evaporators, dry trays, bleaching appliances and a small canning plant.

We ask that the domestic science classes at Davis, as a part of their courses, include the study of the proper utilization and cooking of our distinctively California fruit products.

This matter to be taken up with Dean Hunt.

F. T. SWETT,
G. W. PIERCE,
Committee.

WHEREAS, The Farmers' Protective League, an organization of farmers and friends of agriculture, has been of great assistance to the rural industries of the state, and especially helpful in opposing uncertain, harmful or vicious legislation affecting the business of farming, therefore be it

Resolved, That this convention herewith endorse the work of this league in the past, and approve of its strong support financially, and in every way that may properly protect and advance the interests of California, and

Resolved, That the thanks of this convention be extended to the officers and members of the league for the work accomplished during the two last years guarding and conserving the welfare of the farmers of the state.

WHEREAS, Since our last meeting Providence has called our old friend, Russ D. Stephens, a man who for a quarter of a century has led every fight for the freedom of the California fruit grower from the dominance of powerful interests, and

WHEREAS, He was a man of warm heart and loyal friendships, whose courage never faltered, whose energies and abilities were continually exerted through the years for the common good; therefore be it

Resolved, That the fruit growers of California will long remember the debt we all owe the unconquerable soul of the man who was never afraid to stand up for that which he believed to be just and right. May we never forget his brave example. Be it further

Resolved, That these resolutions be spread on the minutes of this convention and a copy be sent to the family of Mr. Stephens.

WHEREAS, In the death of Dr. A. J. Cook, State Commissioner of Horticulture, the state has lost a conscientious and able official and the fruit growers and farmers of the state one who has for many years devoted his life unselfishly to the upbuilding and development of the agriculture of the state and nation; therefore be it

Resolved, That this convention express its feeling of appreciation of the good work that he accomplished during his long, useful life, and its feeling of great loss in his departure. Be it further

Resolved, That this resolution be spread on the minutes and a copy sent to the family of Dr. Cook.

A. L. WISKER,
C. C. TEAGUE,
C. W. BEERS,
ROY K. BISHOP.
Committee on Resolutions.

COUNTY COMMISSIONERS' DEPARTMENT.

CONIUM MACULATUM.

By J. B. Hickman, Horticultural Commissioner, Monterey County.

The "hemlock" of history and also called by such names as wild parsnip, wild carrot, etc., locally in different places, is certainly poisonous in all parts, though in varying degrees at different periods of growth.

It grows luxuriantly along stream banks throughout the coast sections and in neglected lots and fence corners in every city in the state. For lack of other materials it is frequently used for greens in bouquets and tolerated everywhere from pure ignorance.

According to a circular issued by the United States Department of Agriculture, it claimed as victims an average of four children per year in Philadelphia, and it is more than probable that other cases of mysterious deaths among human beings and animals were caused by this plant.

A somewhat recent circular from the United States Department of Agriculture inclines to the belief that the plant's poisonous properties reside in its root stalk. While this may be true, in cases under observation the author has definite statements of at least six recent cases with fatal results to pigs, goats and calves, and one of poisoning among horses (which, however, recovered) and all were poisoned by eating the young second growth of the plant's leaves.

Usually symptoms of poisoning by this plant are so obscure that the patient is past help before serious danger is suspected.

The plant is a biennial and cutting before seeding means a clean-up in two or three seasons. It is needless to say that *Conium maculatum* should be eradicated.

REVISION IN THE LIST OF COUNTY HORTICULTURAL COMMISSIONERS.

Since the publication of the list of county horticultural commissioners, their deputies and inspectors, in the March *Monthly Bulletin* of this year, the following changes have been made in the staff of commissioners:

Humboldt County.

Commissioner------------------------J. F. Benton, Arcata

Marin County.

Commissioner-------------Thos. P. Redmayne, San Rafael

San Luis Obispo County.

Commissioner----------S. V. Christierson, San Luis Obispo

Yolo County.

Commissioner------------------William Gould, Woodland

ON DELPHASTUS CATALINÆ, A VALUABLE LADYBIRD ENEMY OF THE WHITE FLIES.

By Harry S. Smith and E. J. Branigan.

During the summer of 1915 the junior author, while engaged in colonizing the Sicilian mealybug parasite in the vicinity of Pasadena, came upon a heavy infestation of the white fly, *Aleyrodes kelloggi*, on Catalina cherry. Close inspection revealed the fact that they were preyed upon to a large extent by a tiny reddish-brown ladybird. These were collected and forwarded to the senior author at Sacramento, who had them identified as *Delphastus catalinæ* Horn. Although nothing was found in entomological literature concerning the habits of this ladybird, further study in the field showed that while it fed upon other species than *Aleyrodes kelloggi* it was confined in its food habits to the family known as the White Flies. The fact that it confined its attention to the white flies, but still was sufficiently adaptable to enable it to thrive on various species of that family, immediately suggested to us the possibility of its usefulness in Florida as an enemy of the citrus white fly, the worst insect pest of citrus fruit in that state. It being at that time too late in the year to attempt collection of the ladybird for shipment, it was necessary to postpone any effort in that direction until 1916. Consequently during the present summer the insects were watched for and while they were probably not so abundant as during the previous year, a colony was obtained and sent to the Florida Agricultural Experiment Station at Gainesville. The following letter was received a few days later:

University of Florida,
College of Agriculture,

Gainesville, Fla., Sept. 6, 1916.

Dear Mr. Smith:

Your letter of the 31st ult. arrived this morning. The insects arrived yesterday. Most of them were alive and happy. * * * I at once supplied them with *Dialeurodes citri* and am delighted to report that this morning they are taking to the new material with avidity. They seem to be especially fond of the eggs. Just now the white fly is largely in the egg stage. It is to be hoped that they will like the larvæ equally well. Both larvæ and adults have largely deserted the material that you sent for the fresh. The insect certainly looks promising and to say that we are delighted would be expressing it mildly. * * *

You have placed us under a lasting debt of gratitude for your kindness in this matter and I shall keep you fully informed as to the progress of the colony.

Yours truly,

J. R. Watson,
Entomologist.

A few weeks later Professor Watson wrote us that the ladybirds were laying eggs and had already gone through a generation in his laboratory. Just what will come in a practical way from the introduction of this ladybird into Florida is a matter for conjecture. As a general proposition not much can be expected from natural enemies which are not specific enemies of the pest to be controlled. This is not so true, however, of predators as of parasites, since they have no close physiological interrelations with their host, and the fact as mentioned above, that the ladybird under discussion feeds only upon white flies but is still general enough in its food habits to enable it to thrive on different species of that family leads us to the belief that the experiment is at least well worth attempting.

FIG. 140.—The larva of *Delphastus catalinæ*. Enlarged. (Original.)

There is another important consideration in this connection and that is that so far as we have been able to determine Delphastus will become a new element in the faunal complex of which the citrus white fly forms the central part. We have seen no record of similar species feeding upon the white fly in Florida, although Mr. Woglum found a related form, *Cryptognatha flavescens,* feeding upon the citrus white fly in India. In general, the introduction of predators and parasites which have counterparts in a new region is of little value, while the introduction of new species which form a new element always has great possibilities. The reason for this is that in the first case the introduced insects merely replace a portion of the individuals of the local species, while in the second case the local insects are not replaced, but the effectiveness of the introduced species is simply added to the effectiveness of the species which already occur in the region and which are of different habits. This phenomenon is easily observed in nature. Reasoning from this standpoint, the introduction of Delphastus into Florida should prove of value.

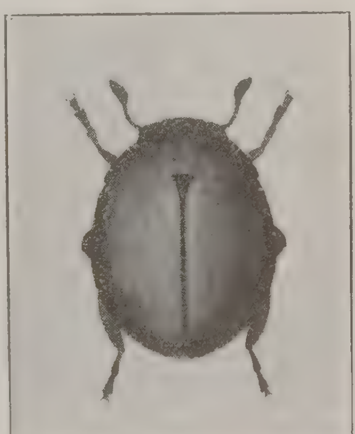


FIG. 141.—The adult of *Delphastus catalinæ.* Enlarged. (Original.)

Delphastus catalinæ is a small chestnut-colored ladybird about 1½ mm. in length. The legs are bright yellow. The larva is white or yellowish white and covered with rather long hairs. It pupates within the larval skin, generally at the base of the tree, on the bark or fallen leaves, frequently in large clusters. Sometimes it crawls into porous soil. The pupa itself is white with black eyes.

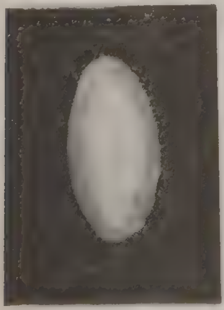


FIG. 142.—The egg of *Delphastus catalinæ.* Enlarged. (Original.)

The ladybird feeds principally upon eggs and newly hatched larvæ of white flies, both in the adult and larval stages. It occasionally also feeds upon the adult insects.

FIG. 143.—Pupal cases of *Delphasus catalinæ* on piece of bark. (Original.)

**Delphastus catalinæ* was originally described by Dr. Geo. H. Horn, in the Transactions of the American Entomological Society, Vol. 22, 1895, pp. 82–85, as *Cryptognatha catalinæ,* from a single specimen captured on Catalina Island by Professor H. C. Fall. Later Captain Thomas L. Casey placed it in the new genus Delphastus which he described in the Journal of the New York Entomological Society, Vol. 7, pp. 111–112.

*We are indebted to Dr. E. C. Van Dyke of the University of California for looking up literature which was inaccessible to us.

QUARANTINE DIVISION.

Report for the Month of October, 1916.

By Frederick Maskew.

SAN FRANCISCO STATION.

Steamship and baggage inspection:

Ships inspected	80
Passengers arriving from fruit fly ports	2,379

Horticultural imports:

	Parcels
Passed as free from pests	108,866
Fumigated	1,002
Refused admittance	52
Contraband destroyed	18
Total parcels horticultural imports for the month	109,938

Pests Intercepted.

From Central America:

Aspidiotus cyanophylli on bananas.
Lepidosaphes gloverii on limes.

From China:

Lepidopterous larvæ in walnuts.
Cylas formicarius in sweet potatoes.
Weevils in chestnuts.

From Hawaii:

Diaspis bromeliæ and *Pseudococcus bromeliæ* on pineapples.
Coccus longulus on betel leaves.
Chrysomphalus aonidum, Lepidosaphes beckii and *Lepidosaphes gloverii* on limes.
Chrysomphalus aonidum and *Pseudococcus* sp. on bananas.

From Holland:

Merodon equestris in bulbs.

From Japan:

Heterodera radicicola in Irish potatoes.
Pseudaonidia duplex on camellia.
Tribolium ferrugineum in ground rice.
Weevils in chestnuts.

From Massachusetts:

Lepidosaphes ulmi on twigs found in barrels of cranberries.

From Mexico:

Pseudococcus sp. on croton.
Chrysomphalus scutiformis on oranges.
Lepidosaphes gloverii on limes.
Calandra oryzæ in canary seed.

From New Zealand:

Psyllids and Aphids on Brachyglottis plants.
Aspidiotus hederæ on palm.
Chionaspis sp. on orchid.

From Pennsylvania:

Leaf miner in Japanese iris.

From Venezuela:

Diaspis boisduvalii and *Isosoma orchidearum* on orchid.

LOS ANGELES STATION.

Ships inspected ---------- 30

Horticultural imports:

	Parcels
Passed as free from pests	116,010¼
Fumigated	24
Refused admittance	10¼
Contraband destroyed	7½
Total parcels horticultural imports for the month	116,052

Pests Intercepted.

From Arizona:

Chrysomphalus aurantii on oranges.

From Arkansas:

Aleyrodes sp. on crape myrtle.

From Central America:

Pseudococcus sp. and *Aspidiotus cyanophylli* on bananas.

From Florida:

Aleyrodes sp. on unidentified shrubs in foliage.

From Kansas:

Cydia pomonella on apples.

From Mexico:

Calandra sp. on tamarinds.
Unidentified Dipterous and Lepidopterous larvæ on dates.

From New Jersey:

Chrysomphalus dictyospermi, Diaspis boisduvalii, Saissetia hemisphærica and *Eucalymnatus perforatus* on orchids.

From New York:

Aleyrodes sp. and *Parlatoria pergandii* on lemon plants.

From New Zealand:

Saissetia oleæ and *Aspidiotus camelliæ* on *Diosma* sp.
Psyllids on *Brachyglottis* sp.

From Oregon:

Rhizoctonia on potatoes.
Lepidosaphes ulmi and *Aspidiotus perniciosus* on apples.

From Pennsylvania:

Aspidiotus hederæ on kentia plants.

SAN DIEGO STATION.

Steamship and baggage inspection:

Ships inspected	25
Fish boats inspected	33
Passengers arriving from fruit fly ports	80

Horticultural imports:

	Parcels
Passed as free from pests	7,853½
Fumigated	2
Refused admittance	1½
Contraband destroyed	26
Total parcels horticultural imports for the month	7,883

Pests Intercepted.

From Iowa:

Crown gall on deciduous stock.

From Mexico:

Coleopterous larvæ (undetermined) in dates.

From Michigan:

Unidentified weevils in ornamental plants.

From New York:

Aspidiotus sp. on orchids.

From Washington:

Common scab on potatoes.

EUREKA STATION.

Steamship and baggage inspection:

Ships inspected ---------- 7

Horticultural imports: Parcels

Passed as free from pests---------- 326

SANTA BARBARA STATION.

(No report.)

ERRATA.

VOL. V.

No. 1.

Page 28. Should be **Grubb** instead of Grugg.

No. 3.

Page 104. Total bearing acreage of apples, **39,210** instead of 38,410.
Total nonbearing acreage of apples, **23,630** instead of 22,430.
Total bearing acreage of apricots, **40,918** instead of 40,898.
Total nonbearing acreage of apricots, **14,578** instead of 14,553.

Page 105. Bearing acreage of lemons in Tulare County, **625** instead of 62.
First column, under olives should be **bearing** instead of nonbearing, and second column **nonbearing** instead of bearing.
Total bearing acreage of olives, **16,054** instead of 15,854.
Total bearing acreage of peaches, **114,175** instead of 113,725.
Total nonbearing acreage of peaches, **31,313** instead of 31,163.
Total bearing acreage of pears, **18,029** instead of 17,779.
Total nonbearing acreage of pears, **19,899** instead of 19,649.
Total bearing acreage of plums, **16,460** instead of 16,410.
Total nonbearing acreage of plums, **5,826** instead of 5,751.

No. 10.

Page 357. **C. I. Lewis** instead of C. L. Lewis.
Page 392. **Chloridea** instead of Chloridia.

INDEX TO VOLUME V.